JOURNAL OF DAIRY SCIENCE

Contents

In Memory of Robert Bear Stoltz. L. H. BURGWALD 1005

The Influence of Water Level and Temperature of Storage on Carotene Preservation in Dehydrated Alfalfa, Cereal Grasses and Mixed Feeds. A. W. HALVERSON AND E. B. HART 1008

Studies on Ruminal Gas Formation and on Consumption of Alfalfa Pasture by Cattle. H. H. COLE AND MAX KLEIBER 1016

A Study of the Use of the Antioxidant Nordihydroguaiaretic Acid in Dairy Products. II. Its Antioxygenic Properties in Unsweetened Frozen Cream. J. W. STULL, E. O. HERREID AND P. H. TRACY 1024

The Relation between the Month of Calving and Yearly Butterfat Production. MOHAMED M. OLOUFA AND I. R. JONES 1029

Some Factors Influencing the Male Hormone Content of Cow Manure. C. W. TURNER 1032

The Influence of the Ration and Rumen Inoculation on the Establishment of Certain Microorganisms in the Rumens of Young Calves. W. D. POUNDEN AND J. W. HIBBS 1041

The Influence of the Ratio of Grain to Hay in the Ration of Dairy Calves on Certain Rumen Microorganisms. W. D. POUNDEN AND J. W. HIBBS 1051

The Influence of the Ration and Early Rumen Development on the Changes in the Plasma Carotenoids, Vitamin A, and Ascorbic Acid of Young Dairy Calves. J. W. HIBBS AND W. D. POUNDEN 1055

The Effect of Supplemental Vitamin A upon the Growth, Blood Plasma Carotene, Vitamin A, Inorganic Calcium, and Phosphorus of Holstein Heifers. R. H. ROSS AND C. B. KNODT 1062

Collegiate Students' International Contest in Judging Dairy Products 1068

Circulation of the Journal of Dairy Science 1071

Author Index of Original Articles 1108

Subject Index of Original Articles 1117

Abstracts of Literature A159

Author Index of Abstracts A167

Subject Index of Abstracts A177

Officers of the Association ii

Table of Contents iii

Errata viii

Vol. XXXI, No. 12, December, 1948

Published by the

AMERICAN DAIRY SCIENCE ASSOCIATION

Profits for dairies... in HANDI-SQUARES!

SAVE SPACE, TIME, MONEY!

Where you had 2 cases of standard rounds, now put 3 cases of Handi-Squares! More efficient use of plant and truck capacity. Handi-Squares' economy continues year after year, quickly absorbs change-over cost.

RETAILERS LIKE 'EM . . . STOCK 'EM!

Retailers can store up to 50% more milk in refrigerators . . . make more sales, profits . . . *without* more storage space. Milk in returnable glass bottles increases traffic, brings *other* sales.

CONSUMERS LIKE 'EM . . . BUY 'EM!

Housewives prefer milk in a *glass* container. They trust its protection of milk's delicate flavor. And they vote 9-to-1 for Squares over any other style of glass container.

USE this space for your dairy's name trade mark or sales message in ACL.

Duraglas HANDI-SQUARE BOTTLES

The trusted protection, unequaled economy of the returnable bottle . . . with new conveniences for the consumer, greater operating efficiency for dairies.

OWENS-ILLINOIS GLASS COMPANY • TOLEDO 1, OHIO • BRANCHES IN PRINCIPAL CITIES

Your advertisement is being read in every State and in 25 Foreign Countries

boost your profits

WYANDOTTE CHEMICALS CORPORATION, world's largest producer of specialized cleaning compounds, is now ready to supply you with a complete farm sanitation program for your farmer-producers.

Included in this program are helpful instructions to the dairy farmer on good sanitary procedure, together with four specialized Wyandotte Compounds covering all phases of the farm sanitation problem.

Wyandotte G.L.X.* is a balanced, *soapless* compound containing wetting agent for removing milk residues from farm equipment. It comes in a covered, multi-purpose 9-lb. metal pail. ***Wyandotte Steri-Chlor**** (in 2 and 5-lb. packages) is an effective, non-corrosive germicide for use on all farm utensils and for washing cows' udders. ***Wyandotte S.R.-10*** furnishes positive milkstone control. It is harmless to utensils and the hands. ***Wyandotte Neosuds**** is a washing compound for use on milking machines and separators where a product with higher wetting agent content is preferred.

Let your Wyandotte Representative show you how you can help your producers—and yourself—by selling complete farm sanitation. You'll profit by giving him a call.

**Registered trade-mark*

protect your products

sell *complete* farm sanitation to your producers

WYANDOTTE CHEMICALS CORPORATION
WYANDOTTE, MICHIGAN • SERVICE REPRESENTATIVES IN 88 CITIES

Wyandotte
REG. U. S. PAT. OFF.

Your advertisement is being read in every State and in 25 Foreign Countries

JOURNAL OF DAIRY SCIENCE

OFFICIAL ORGAN OF
AMERICAN DAIRY SCIENCE ASSOCIATION

Published at
NORTH QUEEN ST. AND MCGOVERN AVE., LANCASTER, PA.

F. E. NELSON, *Editor*
Ames, Iowa

Associate Editors

O. F. HUNZIKER La Grange, Ill.	C. A. CARY Beltsville, Md.	I. W. RUPEL College Station, Tex.	H. A. RUEHE Urbana, Ill.
I. A. GOULD College Park, Md.	G. H. WISE Ames, Iowa	E. P. REINEKE East Lansing, Mich.	P. R. ELLIKER Corvallis, Oreg.

Committee on Journal Management

T. S. SUTTON, *Chairman*
G. H. WISE
P. R. ELLIKER
F. E. NELSON, *ex officio*

Subscriptions. Price ; $6.00 per volume in North and South America; $6.50 in all other countries. Prices are net, postpaid. New subscriptions and renewals are entered to begin with the first issue of the current volume. Renewals should be made promptly to avoid a break in the series. Subscriptions should be sent P. R. Ellsworth, The Ohio State University, Columbus 10, Ohio.

Subscriptions for the British Isles and British Empire, except for Canada and Australia, should be ordered through our agents : Messrs. Bailliere, Tindall and Cox, 7 and 8 Henrietta Streets, Covent Garden, London, W. C. 2, England. Subscriptions for Australia should be sent to our agent : John H. Bryant, Herbert St., St. Leonards, N. S. W., Australia.

Advertising copy should be mailed to P. R. Ellsworth, The Ohio State University, Columbus 10, Ohio. Advertising plates or cuts should be mailed direct to the Business Press, Inc., N. Queen St. and McGovern Ave., Lancaster, Pennsylvania.

Post Office Notices of undeliverable copies and changes of address should be sent to P. R. Ellsworth at the address above stated.

OFFICERS OF THE ASSOCIATION

W. E. PETERSEN, *President*
St. Paul, Minn.
G. M. TROUT, *Vice-President*
East Lansing, Mich.
P. R. Ellsworth, *Acting Sec.-Treas.*
Columbus, Ohio
F. E. NELSON, *Journal Editor*
Ames, Iowa

DIRECTORS

C. Y. CANNON Ames, Iowa	S. J. BROWNELL Ithaca, N. Y.	P. R. ELLIKER Corvallis, Oregon
H. B. HENDERSON Athens, Ga.	P. F. SHARP San Francisco, Calif.	J. H. HILTON Raleigh, N. C.
	P. H. TRACY Urbana, Ill.	

Entered as second-class matter April 13, 1934, at the postoffice at Lancaster, Pa. under the act of March 3, 1879.

New SURGE DAIRY-MAID Water Heater

If you are looking for a bargain—not in price but in years of low cost convenient hot water for your milkhouse... this New SURGE Dairy-Maid is the Heater for YOU!

You can buy heaters for less money—but, we put 15 gallon *copper* tanks in the Dairy-Maid; we insulated with 4 to 5 inches of glass wool; we used *stainless steel* for reservoir, lid, legs, and top . . . we took the design of a heater that is still doing a job after 8 years of rugged use and *improved* on it . . . to offer you a heater that will not only work, but LAST.

Call your Surge Service Dealer and let him SHOW you why the New Dairy-Maid is WORTH more . . . or mail in the coupon below for further details.

BABSON BROS. CO.

2843 W. 19th St., CHICAGO

Copyright 1948 by Babson Bros. Co.

Babson Bros. Co., 2843 W. 19th St., Dept. 8089
Chicago 23, Illinois, U. S. A.

Please send me Catalog pages on the New Surge Dairy-Maid Water Heater and Wash Tank Combination.

Name_____

Town_____ R.F.D._____

State_____

SYRACUSE • TORONTO • MINNEAPOLIS • SEATTLE
KANSAS CITY • HOUSTON • LOS ANGELES • ATLANTA

here it is!
the new meterflo sanitary pump

● Meet the Meterflo — a sanitary positive rotary pump that gives unusually long and satisfactory service. It can be used on practically any liquid product—milk, ice cream mix, cream, buttermilk, evaporated milk, skimmed milk, sour cream, syrups, and whey can all be handled by the Meterflo.

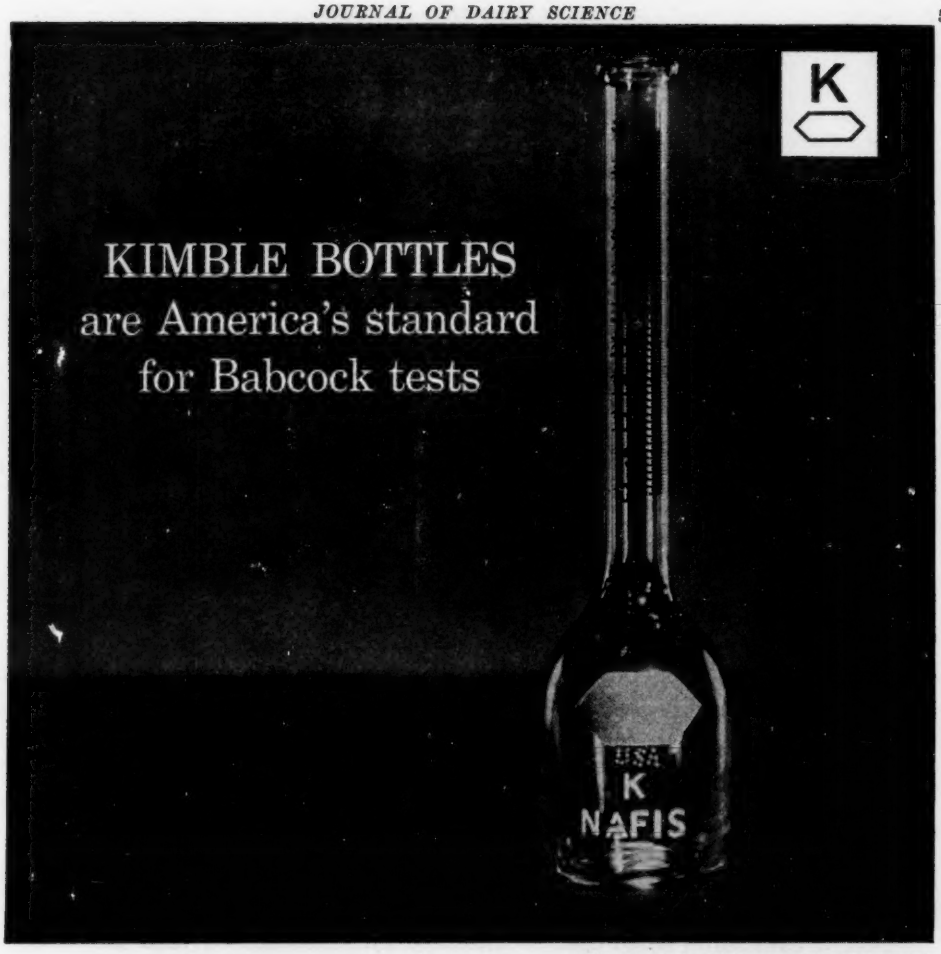
The Meterflo Pump is available with variable speed drives in capacities to suit all dairy plant requirements. For full information, contact your Cherry-Burrell representative, or send in the coupon below.

TEN BIG METERFLO FEATURES

1. *All Stainless Metals*—No copper bearing product contact surfaces.
2. *Clearance or Wear Adjustment*—A built-in adjustment maintains pumping efficiency.
3. *Sanitary Design*—Sloped surfaces and rounded corners. No threads in the product zone, no splines in the milk.
4. *Compact Design*—Requires minimum floor space.
5. *Proved Principle*—Has proved its worth through long, dependable service on the Vogt Freezer.
6. *Easy to Take Apart and Put Together*—No nuts to loosen or tighten within the pump body. Internal parts may be assembled and disassembled without tools.
7. *One Rotary Seal*—The Meterflo Pump has only one shaft and one rotary seal, designed for long life.
8. *No Paper Gaskets*—Eliminates gasket maintenance expense.
9. *Convenient Handwheel Speed Adjustment*—A calibrated handwheel to adjust the variable speed drive is at a convenient height.
10. *Starter or On-Off Switch*—A built-in magnetic switch or push button station is provided, simplifying both installation and operation.

CHERRY-BURRELL CORPORATION
General Sales and Executive Office:
427 W. Randolph Street, Chicago 6, Ill
Milk and Food Plant Equipment and Supplies
FACTORIES, WAREHOUSES, BRANCHES, OFFICES OR DISTRIBUTORS AT YOUR SERVICE IN 56 CITIES
trendmaker in a great industry

CHERRY-BURRELL CORPORATION
Dept. 123
427 West Randolph Street
Chicago 6, Illinois
Please send me complete details on the Meterflo Pump.
Name .....
Company .....
Number and Street .....
City ..... Zone .... State .....



Kimble Babcock Test Bottle No. 2040

WHEREVER Babcock tests are used to determine the quality of dairy products, Kimble Babcock test bottles are standard protection of the accuracy of the tests. Kimble Dairy Glassware meets every Federal and State requirement.

Send for your copy of the Kimble Dairy Manual (3rd Edition) covering methods of testing milk, cream, cheese, ice cream and other dairy products. No obligation. Use Kimble Dairy Glassware for accurate results. Distributed by leading Dairy Supply houses throughout the United States and Canada.

FOR ASSURANCE LOOK FOR THE KIMBLE K—*THE VISIBLE GUARANTEE OF INVISIBLE QUALITY*

KIMBLE GLASS TOLEDO 1, OHIO

Division of Owens-Illinois Glass Company

Your advertisement is being read in every State and in 25 Foreign Countries

UREA

A NEW SOURCE OF PROTEIN FOR RUMINANTS IN

"TWO-SIXTY-TWO"

Feed Compound by Du Pont

DU PONT "Two-Sixty-Two" is a controlled product of high quality which has been used successfully and effectively in more than 2,000,000 tons of commercially mixed feeds for cattle and sheep. It is based on urea, chemically known as carbamide, manufactured by Du Pont. "Two-Sixty-Two" Feed Compound contains 42% nitrogen which can be utilized by ruminants as a source of protein.

Extensive research at many of the leading Agricultural Experiment Stations has proved that synthetic urea is a completely satisfactory and reliable source of protein for ruminants when used as directed. This research covered the important phases of feed utilization of ruminants from both a nutritional and a physiological point of view.

A summary of this information is available along with a bibliography of the research work on the feeding of synthetic urea to ruminants. This summary and a new booklet on the use of "Two-Sixty-Two" in ruminant feeds may be obtained by writing E. I. du Pont de Nemours & Co. (Inc.), Ammonia Dept., Wilmington 98, Delaware.

"TWO-SIXTY-TWO" IS A TRADE MARK, REG. U. S. PAT. OFF.

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

DU PONT TWO-SIXTY-TWO
FEED COMPOUND

Your advertisement is being read in every State and in 25 Foreign Countries

BETTER VANILLA BEGINS HERE

Near the little Spanish town of Mayaguez stands Michael's "vanillery," where carefully placed vanilla vines, on support-trees, are cultivated with tender care. Close by is the U. S. Experimental Station, under a joint long-term research agreement with David Michael & Co., to the end that better vanilla, greater yield, and lower costs may be shared, in turn, with you, the manufacturer of ice cream. Look to Michael's Mixevan for the foremost in research, for the finest in vanilla flavoring.

MICHAEL'S MIXEVAN

Mixevan—"America's Flavorite" and other powdered vanilla products

DAVID MICHAEL & CO.
INCORPORATED
half a century in the flavoring field
3743-63 D St., Philadelphia 24, Pa.

Your advertisement is being read in every State and in 25 Foreign Countries

Look what you get with Patapar*:

IDEAL FOR:

- Butter wrappers
- Ham boiler liners
- Deep freeze wraps
- Fish wrappers
- Milk can gaskets
- Oleomargarine wrappers
- Cheese wrappers
- Can liners
- Vegetable wraps
- Bacon wrappers

and hundreds of other uses

PROTECTION

Patapar Vegetable Parchment gives you a packaging material that really protects. It has high wet-strength. It resists grease. It is made to keep foods fresh and appetizing.

SALES APPEAL

Patapar has a rich white texture that does wonders in dressing up a product. It helps make friends. Helps make sales.

PRINTING SERVICE

Patapar can be printed exquisitely with bright colors and arresting designs. We do the printing in our own plants which are specially equipped for printing Patapar economically by letterpress or offset lithography.

KEYMARK

When you use printed Patapar wrappers you can have the extra advantage of the Patapar Keymark at no extra cost. This nationally advertised symbol on your wrappers reminds people that your product is well protected.

CHOICE OF 179 TYPES

If you need a special type of Patapar we can give it to you. For there are 179 different types of Patapar. This family of types is produced to meet varying requirements of wet-strength, grease-proofness, moisture vapor transmission, thickness, translucency and many other characteristics.

*Reg. U. S. Pat. Off.

Paterson Parchment Paper Company • Bristol, Pennsylvania

Headquarters for Vegetable Parchment Since 1885

WEST COAST PLANT: 340 BRYANT STREET, SAN FRANCISCO 7, CALIFORNIA

BRANCH OFFICES: 120 BROADWAY, NEW YORK 5, N. Y. • 111 WEST WASHINGTON ST., CHICAGO 2, ILL.

7-1373

Your advertisement is being read in every State and in 25 Foreign Countries

ONLY THE DE LAVAL MAGNETIC SPEEDWAY MILKER GIVES YOU THIS

Protection!

UNIFORM MILKING... Not Too Fast; Not Too Slow!

The "magnetic heart" of the De Laval Magnetic Speedway Milker controls pulsations for each operating unit. Pulsation speed cannot vary; all units milk alike at every milking.

UNIFORM VACUUM... Not Too High; Not Too Low!

Positive De Laval Speedway Vacuum Controller assures correct vacuum for best milking at all times. Non-adjustable for perfect milking assurance.

UNIFORM OPERATION... No Adjustments!

No pulsators or surcingles to adjust from cow to cow or from milking to milking. Simply set unit on floor, attach vacuum hose to automatic stall cock and attach teat cups.

ONLY DE LAVAL

Only the De Laval Magnetic Speedway Milker gives you the "Magnetic Heart" which assures UNIFORM milking and which means highest milk yield per cow, greatest profits.

New De Laval Sterling Milker

Another great new De Laval Milker for still better milking. New stainless steel units and pump.

New De Laval World's Standard Series Separators

The cleanest skimming, easiest-to-clean separators ever built. Every part milk touches is stainless steel. Hand or motor drive.

New De Laval Speedway Water Heater

De Laval engineered for the dairyman. Supplies 12 full gallons of 185° water. "Lifetime" copper tank.

New De Laval Speedway Vacuum Can Hoist

Takes the work out of loading and unloading the milk cooler. Operates on vacuum supplied by milker pump.

De Laval

THE DE LAVAL SEPARATOR COMPANY

SPEEDWAY

The De Laval Separator Company, Dept. 21-O.
165 Broadway, New York 6, N. Y.
Please send me printed matter on:

☐ De Laval Milkers ☐ De Laval Water Heaters
☐ De Laval Separators ☐ De Laval Milking Truck
☐ De Laval Freezers ☐ De Laval Can Hoist

Name_____

Town_____ RFD____ State_____

Your advertisement is being read in every State and in 25 Foreign Countries

A PLEDGE

We have greatly enjoyed the opportunity afforded by this page to acquaint Extension Dairymen and staff-members of the various Dairy Husbandry Departments with our programs, our plans and our ideals.

It has provided us with a means of discussing problems of mutual interest with you who are the leaders in the profession. It has been one way in which we could briefly tell you of the things we are doing and the things we plan on doing, to promote and improve our breed in particular, and dairying in general.

It now provides us with one more occasion to repeat our pledge of working with The American Dairy Science Association, The Purebred Dairy Cattle Association and the State Colleges of Agriculture toward that which is the common interest of us all, Better Dairying.

The American Jersey Cattle Club

Columbus 15, Ohio

Your advertisement is being read in every State and in 25 Foreign Countries

JOURNAL OF DAIRY SCIENCE

VOLUME XXXI DECEMBER, 1948 NUMBER 12

IN MEMORY OF ROBERT BEAR STOLTZ

On October 2, 1948, the bottom seemed to drop out of many, many lives, for on that day Robert Bear Stoltz was called to a greatly needed rest by his Maker. Great was the loss felt by his family and the host of friends he left behind. On the day of his burial, even the heavens wept unashamedly.

The greatness of Robert Stoltz can best be measured by the record of his achievements. His motto could easily have been, "What do we live for, if it is not to make life less difficult for others".

He was first of all a wonderful husband and father of four children, and took great pride and joy in his five grandchildren.

He was a true friend and wise councilor, none ever were better, for he had the wisdom, tact and diplomacy that rarely is found today.

He truly was a great educator, administrator and organizer.

Professor Stoltz was 58 years old, a relatively young man, but one who had crammed more genuine greatness and achievement in that short span than many who live 20 to 30 years longer. He was an untiring and thorough worker.

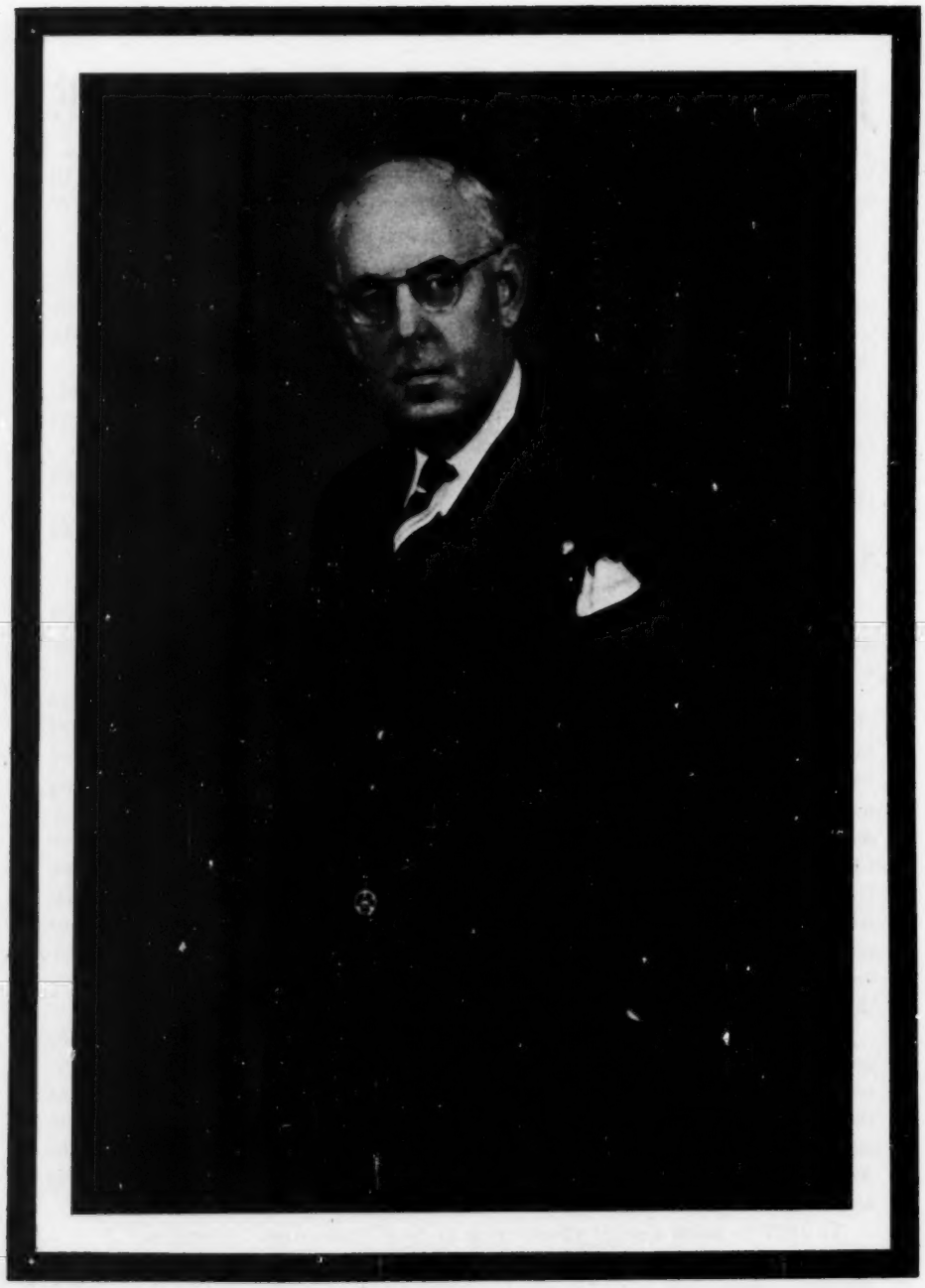
Professor Stoltz had been associated with the Ohio State University, College of Agriculture since his graduation in 1912. In 1923 he was promoted to full professor, and in 1929 he was made the chairman of the then newly organized department of Dairy Technology. This department soon became outstanding under Professor Stoltz' guidance for the backing it received from the dairy industry in the State. He was instrumental in the organization of the Ohio Swiss Cheese Association in 1918, and was its secretary and treasurer until 3 years ago. He also promoted the organization of the Columbus Milk Distributors Association in 1934 and was its secretary until 3 years ago. This organization has done much to promote friendly relations among its members. He was also instrumental in their adoption of the universal milk bottle shortly after the organization was founded.

Other organizations recognized Professor Stoltz' ability. He was at one time secretary of the National Cheese Association, and since 1936 he was secretary-treasurer of the American Dairy Science Association, after being president of this organization in 1934. He did much to increase the membership of this organization and put it on a sound financial basis. In 1947 he was presented with the Association Award giving him honorary life membership in the ADSA. He was also a member of the Advisory Council of Sealtest, Inc.

In 1937 he made a study of dairying in New Zealand and Australia.

Ever mindful of both education and the dairy industry, he believed in turning out students well versed in the fundamentals of dairying and in the psychology of "how to win friends and influence people."

Copyright, 1948, by the AMERICAN DAIRY SCIENCE ASSOCIATION



Because sufficient funds were unavailable at Ohio State University for research in dairy technology, Professor Stoltz, as an honorary member of the Board of Trustees of the Ohio Dairy Products Association in an advisory capacity, suggested and worked diligently toward the promotion of a research fund by the dairy industry in the State. This fund, known as the Ohio Dairy Products Research Fund, became a reality and today amounts to considerably more than $100,000, the interest on which at 6 per cent is used for research in dairy technology at The Ohio State University. It has since been suggested that the name of this fund be changed to the Robert B. Stoltz Memorial Research Fund.

Professor Stoltz was listed in *Who's Who in America, Who's Who in American Education,* and in *American Men of Science.* He was a member of the Ohio Post-War Program Commission, and of the Columbus Rotary Club.

Professor Stoltz was very active in Masonry, and if ever a man was a true Mason and lived up to the Masonic Creed, it was Bob Stoltz. He was a 33rd degree Mason, and was elected this year as Deputy General Grand Master of the General Grand Council, R. & S. M., of the United States; had served as Grand Master of the Grand Council, R. & S. M. of Ohio; was Past Master of University Lodge and for 14 years its secretary; a member of York Chapter, R. A. M.; York Council, R. & S. M.; Columbus Commandery, Scottish Rite; Aladdin Temple; and Red Cross Constantine.

He was a member of Acacia Fraternity, and Delta Theta Sigma and Gamma Sigma Delta honorary fraternities.

Professor Stoltz was a native of Bradford, Ohio, where he was born March 6, 1890. Surviving are his widow, Mrs. Marie Cassel Stoltz, a son, Philip, three daughters, Mrs. Bonnie Marie Downes, Mrs. Susan Ann George, and Mrs. Roberta Mary Miles.

"Patience, kindness, generosity, humility, courtesy, unselfishness, good temper, guilessness, sincerity—these make up the supreme gift, the stature of the perfect man." If that is so, then Bob Stoltz was a perfect man because he possessed all of them to a very marked degree.

L. H. BURGWALD

THE INFLUENCE OF WATER LEVEL AND TEMPERATURE OF STORAGE ON CAROTENE PRESERVATION IN DEHYDRATED ALFALFA, CEREAL GRASSES AND MIXED FEEDS[1]

A. W. HALVERSON AND E. B. HART

Department of Biochemistry, College of Agriculture, University of Wisconsin, Madison

In earlier papers (2, 3), it was pointed out that the carotene of dehydrated alfalfa or dehydrated cereal grasses could be preserved completely if the water content was adjusted to 12 to 20 per cent level and the material stored at 22 to 25° C. in airtight containers. It was postulated that this preservation was related to the speed of reaction of respiratory enzymes which in turn was related to the moisture content of the material.

EXPERIMENTAL

Further studies now have been made with lower water levels in these dehydrated materials stored for 3 months at 22 to 25° C. and 33 to 36° C., respectively. The water levels ranged from 0.9 to 15 per cent with graded increments generally of 2.5 per cent. The materials used were: (a) A dehydrated commercial alfalfa prepared in October, 1947, with an initial carotene content of approximately 350 γ per g. and a water content of 3.6 per cent. (b) An alfalfa cut from a University field in September, 1946, and dried in the laboratory at 50° C. This product was dried further in a vacuum oven for 24 hours at 50° C. prior to starting the experiment. The material, when put up for experimental observation, had a carotene content of approximately 150 γ per g. It consisted of both stem and leaf. (c) A dehydrated alfalfa[2] which was dried for 2.5 hours at 95° C. before being used in these water level experiments. It contained 154 γ of carotene per g. (d) A dehydrated cereal grass[2] which contained approximately 160 γ of carotene per g. and was dried for 2.5 hours at 95° C. before being used in the experiments.

All of these materials were adjusted to different water levels and placed in ice cream cartons holding about 250 g. The control was unwaxed, and the remaining cartons were dipped several times in Flexowax to insure complete exclusion of oxygen. They then were stored at 22 to 25° C., and duplicate sets stored at 33 to 36° C. for 3 months. At the end of that time, the cartons were opened, sampled for carotene determination and observations on color and aroma made. The data giving the results are found in tables 1 through 4.

Since it was possible to preserve the carotene in these dehydrated materials

Received for publication June 5, 1948.

[1] Published with the approval of the Director of the Wisconsin Agricultural Experiment Station. Supported in part by the Research Committee of the Graduate School from funds supplied by the Wisconsin Alumni Research Foundation. The authors extend their appreciation to the Cerophyl Laboratories, Inc., Kansas City, Missouri, for the dehydrated alfalfa and cereal grasses and to Mr. F. C. Dulmage, Dow Chemical Company, Midland, Michigan, for the Saran sheets and miniature Saran bags.

[2] Supplied by the Cerophyl Laboratories, Inc., Kansas City, Mo.

TABLE 1

Effect of water level and temperature on carotene, color and pressure of dehydrated alfalfa a. (Carotene data on water free basis)

Treatment	Color	Gas pressure	% water	Carotene content		
				Initial (γ/g.)	3 months (γ/g.)	% loss
		Stored at 22 to 25° C.				
No seal	Green	None	5.2	338	118	67.0
Sealed	Green	None	0.9	338	223	34.0
Sealed	Green	None	2.5	338	248	26.0
Sealed	Green	None	5.0	356	338	5.3
Sealed	Green	None	7.5	356	344	3.6
Sealed	Green	None	10.0	356	362	0.0
Sealed	Slight olive green	None	12.5	356	371	0.0
Sealed	Olive green	None	15.0	356	376	0.0
		Stored at 33 to 36° C.				
No seal	Green	None	3.6	338	66	81.5
Sealed	Green	None	0.9	338	230	32.0
Sealed	Green	None	2.5	338	259	23.0
Sealed	Green	None	5.0	356	329	8.0
Sealed	Green	None	7.5	356	348	2.5
Sealed	Olive green	Positive	10.0	356	350	2.0
Sealed	Brown	Positive	12.5	356	363	0.0
Sealed	Brown	Positive	15.0	356	356	0.0

by the procedure outlined, it seemed important to study the losses of carotene in a mixed feed such as is often used in dairy, poultry and hog rations. The ration fed consisted of: soybean meal, 20 per cent; wheat middlings, 20 per cent; wheat bran, 10 per cent; white corn, 21 per cent; oats, 10 per cent; alfalfa

TABLE 2

Effect of water level and temperature on carotene, color and pressure of air dried alfalfa b. (Carotene data on water free basis)

Treatment	Color	Gas pressure	% water	Carotene content		
				Initial (γ/g.)	3 months (γ/g.)	% loss
		Stored at 22 to 25° C.				
No seal	Green	None	6.9	164	122	25.6
Sealed	Green	None	3.4	157.6	129	18.2
Sealed	Green	None	5.0	157.6	136	13.7
Sealed	Green	None	7.5	157.6	144	8.4
Sealed	Green	None	10.0	157.6	146	7.0
Sealed	Slight olive green	None	12.5	157.6	159	0.0
Sealed	Olive green	None	15.0	164	162	1.2
		Stored at 33 to 36° C.				
No seal	Green	None	5.2	164	70	57.0
Sealed	Green	None	3.4	157.6	115	27.0
Sealed	Green	None	5.0	157.6	120	24.0
Sealed	Green	None	7.5	157.6	131	17.0
Sealed	Slight olive green	None	10.0	157.6	140	11.0
Sealed	Slight olive green	Positive	12.5	157.6	136	14.0
Sealed	Olive green	Positive	15.0	164	147	11.0

TABLE 3

Effect of water level and temperature on carotene, color and pressure of dehydrated alfalfa c. (Carotene data on moisture free basis)

Treatment	Color	Gas pressure	% water	Carotene content		
				Initial (γ/g.)	3 months (γ/g.)	% loss
		Stored at 22 to 25° C.				
No seal	Green	None	4.4	154	95	38.0
Sealed	Green	None	3.7	154	111	28.0
Sealed	Green	None	5.0	154	117	24.0
Sealed	Green	None	7.5	154	138	10.4
Sealed	Green	None	10.0	154	139	9.7
Sealed	Slight olive green	None	12.5	154	149	3.2
Sealed	Slight olive green	None	15.0	154	159	0.0
		Stored at 33 to 36° C.				
No seal	Green	None	3.1	154	68	55.0
Sealed	Green	None	3.7	154	104	32.0
Sealed	Green	None	5.0	154	116	24.0
Sealed	Green	None	7.5	154	132	14.0
Sealed	Slight olive green	None	10.0	154	144	6.5
Sealed	Olive green	None	12.5	154	154	0.0
Sealed	Olive green	Positive	15.0	154	159	0.0

meal, 15 per cent; $CaCO_3$, 2 per cent; $Ca_3(PO_4)_2$, 1 per cent; and iodized salt, 1 per cent. The only major source of carotene in this feed was the 15 per cent alfalfa meal. The feed was stored at 33 to 36° C. for 3 months with water levels

TABLE 4

Effect of water level and temperature on carotene, color and pressure of Dehydrated cereal grass d. (Carotene data on water free basis)

Treatment	Color	Gas pressure	% water	Carotene content		
				Initial (γ/g.)	3 months (γ/g.)	% loss
		Stored at 22 to 25° C.				
No seal	Green	None	4.4	166	110	34.0
Sealed	Green	None	1.6	166	115	31.0
Sealed	Green	None	2.5	166	123	26.0
Sealed	Green	None	5.0	166	133	20.0
Sealed	Green	None	7.5	166	146	12.0
Sealed	Green	None	10.0	166	155	6.3
Sealed	Faint olive green	None	12.5	166	161	3.0
Sealed	Olive green	None	15.0	166	174	0.0
		Stored at 33 to 36° C.				
No seal	Green	None	3.0	166	74	55.0
Sealed	Green	None	1.6	166	104	37.0
Sealed	Green	None	2.5	166	112	33.0
Sealed	Green	None	5.0	166	136	18.0
Sealed	Faint olive green	None	7.5	166	150	9.7
Sealed	Olive green	None	10.0	166	164	1.2
Sealed	Olive green	None	12.5	166	164	1.2
Sealed	Brown	None	15.0	166	172	0.0

ranging from 2.3 to 15 per cent under sealed and unsealed conditions. The initial moisture was reduced by drying for 2.5 hours at 95° C. A companion series also was set up but with the addition of certain trace elements now commonly used in such mixed feeds. This series which contained the trace elements was dried initially for 32 hours at 50° C. in a vacuum oven. The trace elements used were 0.02 per cent $FeCl_2 \cdot 4H_2O$, 0.02 per cent $CuSO_4 \cdot 5H_2O$, 0.25 per cent $MnSO_4 \cdot H_2O$ and 0.02 per cent $CoCl_2 \cdot 6H_2O$.

At the end of 3 months, these cartons were opened, carotene determinations made, as well as observations on color, flavor, aroma, rancidity and other characteristics. The initial carotene content of this feed was 39.6 γ per g. It is assumed that practically all of the carotene was in the 15 per cent of alfalfa meal.

The determination of carotene in the mixed feed by the Wilkes method (4) gave high results. This method seemed entirely satisfactory where only alfalfa or a cereal grass was involved, but when applied to the mixed feed with 15 per cent of alfalfa, the results often were 50 per cent too high. This assumes that there was complete carotene conservation with 12.5 to 15 per cent of water when sealed. Apparently, certain interfering pigments which developed during storage were registering as carotene by the Wilkes method.

The Wilkes method was abandoned for the mixed feed analysis, and the general procedures for chromatographic analysis of carotene which are given in *Methods of Vitamin Assay* (1) were incorporated in the determination. The extraction consisted of allowing 1 to 2 g. of sample to stand 16 to 18 hours (in the dark) in 60 ml. of a 2:1 mixture of Skelly B and acetone. After filtering to remove the sample, the extract was evaporated on a steam bath to reduce the total volume to about 50 ml. Saponification was accomplished next by adding 80 ml. of 5 per cent alcoholic KOH to the extract and allowing the solution to stand in the dark for at least 15 minutes.

The Skelly B phase was obtained by the addition of 40 ml. of water. Following re-extraction of the alcoholic phase twice with 25 ml. portions of Skelly B, the combined Skelly extracts were washed five times with distilled water. The extract was evaporated down, and the final traces of moisture were removed under vacuum. Ten to 15 ml. of Skelly B were added immediately to the dried pigments which now were ready to be chromatogramed. The adsorbent employed in the column was a 1:1 mixture of MgO (Micron Brand, no. 2641, Westvaco Corp., Newark, Cal.) with Hyflo Super-Cel (Johns Manville). Following adsorption, the pigments were eluted with a 2 per cent solution of dry acetone in Skelly B. The pigment passing through the column was considered as carotene, and the carotene content of the sample was calculated by standard procedures using pure β-carotene as the reference standard.

The data secured in this experiment are shown in table 5. The striking observation made on these samples was the rancid odor and bleached color in the non-waxed carton containing the trace elements and the total absence of these characteristics when the oxygen was excluded by waxing. When the oxygen was excluded, the greenish color and clean pleasant aroma persisted in all the samples, although with 15 per cent of water the color was slightly olive green.

TABLE 5

Effect of water level, temperature, trace elements, on carotene, color, aroma and pressure of mixed feed with 15 per cent alfalfa stored at 33 to 36° C. (Carotene data on water free basis)

Treatment	Color	Gas pressure	% water	Carotene content		
				Initial (γ/g.)	3 months (γ/g.)	% loss
			No trace elements, Fe, Cu, Mn, Co			
No seal	Bleached	None	3.6	39.6	2.7	93.2
Sealed	Green	None	2.3	39.6	13.7	65.4
Sealed	Green	None	5.0	39.6	16.6	58.1
Sealed	Green	None	7.5	39.6	34.4	13.1
Sealed	Green	None	10.0	39.6	40.8	0.0
Sealed	Green	None	12.5	39.6	41.0	0.0
Sealed	Slight olive green	Positive	15.0	39.6	42.6	0.0
			Plus trace elements, Fe, Cu, Mn, Co			
No seal	Bleached[a]	None	4.3	39.6	1.1	97.3
Sealed	Green	None	3.2	39.6	3.8	90.5
Sealed	Green	None	5.0	39.6	6.9	82.5
Sealed	Green	None	7.5	39.6	27.0	31.8
Sealed	Green	None	10.0	39.6	41.8	0.0
Sealed	Green	None	12.5	39.6	46.0	0.0
Sealed	Slight olive green	None	15.0	39.6	46.3	0.0

[a]Rancid aroma; all other samples had a pleasant aroma.

In the series without the trace elements, the unwaxed material was bleached but possessed a clean non-rancid aroma. In the waxed samples, the greenish color and pleasant aroma persisted in all the samples, although with 15 per cent of water the product was slightly olive green with a slight fermentation aroma.

Involved in the development of the process of carotene preservation in the materials investigated is the question of an economical, practical airtight re-

TABLE 6

Record of preservation of the carotene of dehydrated alfalfa in single thicknesses of Saran tubes (200 gauge). Stored at 33 to 36° C. for 2 months. (Carotene data on water free basis)

Treatment	Color	Gas pressure	% water	Carotene content		
				Initial (γ/g.)	3 months (γ/g.)	% loss
No seal	Green	None	4.2	377	127	67.0
Sealed[a]	Green	None	7.5	377	368	2.3
Sealed	Green	None	7.5	377	364	3.4
Completely waxed	Green	None	7.5	377	366	2.8
Sealed	Green	None	10.0	377	372	1.3
Sealed	Green	None	10.0	377	346	8.0
Completely waxed	Green	None	10.0	377	372	1.3
Sealed	Olive green	None	12.5	377	363	3.7
Completely waxed	Olive green	None	12.5	377	361	3.9

[a] Sealed refers to Saran tubes, waxed only at the end tube joint.

ceptacle. Materials such as tin and iron would be available, but prices probably would prohibit their general use. Sheet aluminum has been tried but is liable to have pin holes and was not effcetive. Fiber cartons allowed air transmission and gave negative results even when lined with asphalt or paraffin paper liners. Waxed cartons were very effective but the process of waxing did not seem practical. Bags made with Kraft paper treated with Melamine resin were not effective. Among the plastics, polyethylene pouches in Kraft paper bags were tried but found ineffective. The oxygen and carbon dioxide transmission rates of cellophane, nylon, parafilm, pliofilm and polyvinyl alcohol were considered too high to warrant a trial.

Saran, a vinyl-vinylidene chloride copolymer manufactured in various thicknesses was investigated. The 200 gauge material was made into tubes about 1 foot long and sealed at the ends and seams with Flexowax. These tubes were filled with dehydrated alfalfa with varying water content (7.5, 10 and 12.5 per cent) and stored at 33 to 36° C. for 2 months. The records with Saran are shown in table 6. The carotene losses were practically zero. While no claim is made that this material is absolutely negative to oxygen and carbon dioxide transmission, yet the rates of transmission must be very low, even where the alfalfa contained 15 per cent of water. Methods of using this material for the production of a bag or a carton suitable for use in the dehydrated alfalfa and dehydrated cereal grass industry are in progress. It also would appear that such an oxygen-impervious bag or receptacle would find large application in the feed and food industry, where exclusion of oxygen from materials surrounded by an inert gas such as carbon dioxide or nitrogen is desirable.

DISCUSSION

The data on the four dehydrated materials show that a definite level of water with exclusion of oxygen can preserve the carotene of these materials. In a previous study (3), the authors demonstrated the effect of moisture upon the rate of respiration in dehydrated materials. A water content of 5 to 7 per cent or lower apparently does not allow a sufficiently rapid rate of oxygen utilization to prevent significant carotene destruction. Dehydrated materials containing 7.5 per cent or more of moisture when sealed showed good carotene preservation; hence, it is concluded that the oxygen tension in such samples is reduced to a low level in a period of a few days. When the water level is above 10 per cent, the partial destruction of chlorophyll generally supervenes. This is especially true when the storage temperature is as high as 33 to 36° C. for 3 months. Shorter periods of storage at such high temperatures may not affect seriously the green color. Since a green color of the product is much prized by the trade, a water level of about 10 per cent under sealed conditions is recommended to achieve a high preservation of the carotene and maintain the green color.

One must expect variation in the behavior of these dehydrated plant materials to the process outlined. Early harvested materials may have a different rate of respiration than those harvested late in the season. A leaf meal would be

expected to behave differently than a meal composed of both leaf and stem. The season's rain fall, the latitude, the type of soil and the method of dehydration all may have their influence on the behavior of these plants under storage. The length of the period between havesting and storage also may be an important factor. These problems might well be studied.

The results on carotene preservation in a mixed feed under sealed conditions, with or without trace elements, are especially interesting. That the carotene from only 15 per cent of alfalfa in a mixed feed can be preserved when the oxygen is excluded is important information. It is believed that not only does the alfalfa respire and use up the oxygen when there is a proper moisture content, but that other plant materials also will respire and supplement the activity of the alfalfa. However, this point has not been proven definitely, but since the carotene was preserved in a mixed ration containing only 15 per cent alfalfa (principal carotene source), it is logical to conclude that other plant tissues are contributing to the respiration.

The green color was well preserved when the mixed feed was sealed while the unsealed product became distinctly bleached. Further, in the presence of the trace elements, the unsealed material developed a definite rancid odor, a condition that did not develop in the absence of the trace elements under sealed and unsealed conditions. Consequently, it would seem unwise to add these trace elements to a mixed feed that is to be stored for months and where free access to oxygen is allowed. Some other vehicle, probably common salt, should be used for providing additional trace elements when needed by our livestock.

Many trials were made of materials presumed to be airtight. It is imperative that receptacles for carrying out the outlined process for carotene preservation be airtight, that is, made of materials that will retain the carbon dioxide generated within and prevent the transmission of oxygen into the receptacle. Flexowax was effective but probably impractical. There may be other suitable waxes, but this was the only one tried. Among the plastic films, Saran (Dow Chemical Company) possessed a high preservation quality. It has a high tensile strength and should lend itself to the solution of the problem involved in these studies. Other suitable plastic films may be found.

In practice it is correctly assumed that storage of feed materials with a high water content may lead to the growth of molds and even spontaneous combustion. Both conditions are governed by access to oxygen. With a process that excludes oxygen or greatly lowers its tension, common molds cannot grow and combustion cannot start.

SUMMARY

1. The effect of moisture level and temperature on carotene losses in dehydrated alfalfa and cereal grasses was studied under sealed conditions. The moisture levels studied were 2.5 to 15 per cent and the temperatures employed were 22 to 25° C. and 33 to 36° C.

2. In most instances, almost complete carotene preservation resulted with 10 to 15 per cent of water. Preserving both the carotene and the green color

was best accomplished at 7.5 to 10 per cent of water with 10 per cent as the preferred level because of the more optimum carotene preservation with no detrimental color change. At 7.5 per cent of water, the amount of loss was unpredictable and varied from 2.5 to 17 per cent. The losses increased with decreasing water levels below 7.5 per cent and at 2.5 to 5 per cent varied from 5 to 32 per cent.

3. Storage at 22 to 25° C. (room temperature) was more favorable for the preservation of the green color at 10 to 15 per cent of water level than storage at 33 to 36° C. Little difference in color preservation was observed at either temperature with the moisture below 10 per cent. Postitive pressures seldom were observed with 10 per cent moisture or less and storage at 22 to 25° C.

4. Storage under sealed conditions at 33 to 36° C. of a mixed feed containing 15 per cent alfalfa as the main source of carotene resulted in complete carotene retention with 10 per cent of moisture. Below 7.5 per cent the losses were large. The feed became bleached in the unwaxed carton but retained a pleasant aroma. In waxed cartons feed at any moisture level remained green and had pleasant aromas.

5. Where the mixed feed contained the added trace elements Fe, Cu, Mn and Co, the contents of the unwaxed carton were bleached and also possessed a rancid or tallowy odor. Under sealed conditions the green color and fine aroma were retained, and at 10 per cent and above of water, the carotene was preserved completely.

6. Investigation of many materials as barriers to oxygen and carbon dioxide transmission finally led to the use of Saran, a plastic film. It was found effective for the preservation of carotene in dehydrated alfalfa, with a proper water level.

REFERENCES

1. Assoc. of Vitamin Chemists, Inc. Methods of Vitamin Assay. Interscience Publishers, Inc., N. Y. 1947.
2. Halverson, A. W., and Hart, E. B. The Stabilization of Carotene in Dehydrated Legumes (Alfalfa) and Cereal Grasses. J. Dairy Sci., **30**: 245–253. 1947.
3. Halverson, A. W., and Hart, E. B. Further Studies of the Processes Involved in the Preservation of Carotene in Dehydrated Alfalfa and Cereal Grasses. J. Dairy Sci., **30**: 763–768. 1947.
4. Wilkes, J. B. Chromatographic Determination of Carotene. Ind. Eng. Chem. (Analyt. Ed.), **18**: 702–707. 1946.

STUDIES ON RUMINAL GAS FORMATION AND ON CONSUMPTION OF ALFALFA PASTURE BY CATTLE

H. H. COLE AND MAX KLEIBER
Division of Animal Husbandry, University of California, Davis

This paper is concerned with the effect of diet on ruminal gas formation and with studies on the consumption of legume pasture. It was shown earlier (2) that no more gas was formed on a bloat-provoking diet such as green alfalfa tops than on a non-bloat-provoking diet such as alfalfa hay and grain. This observation led to the conclusion that increased gas production in itself could not explain acute bloat. In the same paper, it was shown that the rate of gas production depended upon the amount of feed consumed. Furthermore, both the present authors (2) and Quin (6) have shown by introducing gas into the rumen that much more can be expelled by belching than ever is produced in the rumen. Consequently, the hypothesis that acute bloat is due to a lack of sufficient coarse roughage in the rumen to induce eructation has been suggested (2). With this hypothesis, the rate of gas production is still an important consideration because belching rarely, if ever, is completely inhibited on diets low in coarse roughage. On the basis of this theory, it has been possible to induce and prevent bloat at will (3). Nevertheless, fatal bloat is not always produced on all succulent fields, and this failure has appeared to be due to a low consumption of alfalfa.

Quin (6) has suggested that bloat depends on both a high sugar content of the legumes at certain times which accelerates gas production, and a high saponin content which results in foaming with a consequent trapping of the gas and which thus prevents eructation. In support of the importance of the first factor, he submits evidence that glucose added to ruminal contents speeds up gas production more than does the addition of starch. The second postulate was based on his observation that ruminal ingesta from animals fed on alfalfa had a greater tendency to foam than ingesta from animals on other feeds, and on the report of Jacobson (4) that alfalfa contains a saponin with strong foam-producing properties. The results reported in the present paper confirm Quin's finding that glucose, under certain conditions, results in a more immediate increase in gas production than does starch, but further work is necessary to establish the view that changes in sugar content play a major role in determining the incidence or severity of bloat. The present authors have stuck a number of bloated cattle and find that foaming is not the cause of many cases of bloat. In one animal near death, the excess gas easily escaped when the animal was stuck with a trocar cannula, and in another severely bloated animal the excess gas with withdrawn by means of a stomach tube without obstruction by foaming. However, foaming may prevent eructation under certain conditions.

Received for publication June 12, 1948.

EXPERIMENTAL

Dairy cows, in most instances lactating Jerseys, were used in the present studies. The method used for determining the rate of gas production has been described (2) as also has the method for determining food consumption on pasture (1). The rumen was tapped for gas production by means of a trocar cannula intended for bleeding horses.

Ruminal Gas Production Studies

Comparison of gas production on green alfalfa tops and on green Sudan grass. Although the rate of gas production on non-bloat-provoking diets such as alfalfa hay and grain has been compared to that on green alfalfa tops,

TABLE 1

Comparison of ruminal gas formation following feeding of Sudan and alfalfa tops. The cows were fed ad libitum throughout the 4-hour experimental period

Cow no.	Pounds of Sudan or alfalfa tops consumed[a]	Cubic feet of gas formed:		
		Half-hour before feeding	Half-hour after feeding	First 4 hours after feeding
		Sudan tops		
760	69.7	0.08	0.28	4.02
760	50.4	0.26	0.47	5.43
757	7.5	0.32	0.47	2.77
760	63.0	0.34	0.59	6.70
Av.	47.6	0.25	0.45	4.73
		Alfalfa tops		
760	16.9	0.06	0.48	4.17
757	2.4	0.34	0.28	3.29
760	19.7	0.30	0.78	6.82
832	12.9	0.34	0.43	3.00
Av.	15.5	0.26	0.49	4.32

[a] In addition to the tops, cow 760 received 4 pounds of a concentrate mix the night before the trial. Cows 757 and 832 received 4 pounds of concentrates the night before and the morning of the trial.

grasses have not been compared with legumes. Because bloat rarely occurs on grasses, this comparison seemed desirable.

The alfalfa and Sudan tops were cut and fed in the barn. The cows were pastured on the field from which the tops were to be taken for two days preceding the trial. No hay was fed the night previous or on the morning of the trial, but the regular concentrate allowance was given (4 to 8 lb. per day, depending on milk production). Gas production was determined over a 30-minute control period before feeding the alfalfa or Sudan. The object of the experiment was to determine the amount of gas formed on the two feeds when cows were given free access to the feed over a 4-hour experimental period. The results are shown in table 1. The gas formation during the first 4 hours after the beginning of feeding was approximately the same for the two feeds, but the average consumption of Sudan was three times that of alfalfa. Conse-

quently, it appears that the rate of gas production would be greater with alfalfa than with Sudan if equal quantities were fed.

Cow 757 ate very little during the gas determination period, as she was distressed by the presence of the cannula. Cow 760, on the other hand, evidenced no discomfort upon insertion of the trocar cannula; she continued to eat and ruminate in a normal manner. These individual differences are mentioned to point out that the use of the trocar cannula in gas production studies necessitates some discrimination in the selection of suitable experimental subjects.

It may be noted that there is an increase in gas production during the first 30 minutes after feeding (table 1). The promptness of acceleration of ruminal gas formation following ingestion of feed is an interesting phenomenon. On a given feed, there are some discrepancies between the amount consumed and the volume of gas formed which are difficult to explain. The amount of feed consumed was not measured on the 2 days preceding the test, and it may be that variations in the volume of ingesta present in the rumen at the beginning of the trial may provide an explanation.

TABLE 2

Comparative effects of glucose and starch on ruminal gas formation in cows given free access to green alfalfa tops for 4 hours preceding the experimental period. Two kg. of starch or glucose in 6 liters of H_2O were administered through a cannula directly into the rumen

Cow no.	Drench	Cubic feet of gas formed:		
		Hour before drench	Hour after drench	Second hour after drench
760	glucose	1.50	1.56	1.69
832	glucose	0.73	0.85	0.76
	Av.	1.12	1.21	1.23
760	starch	1.14	1.14	1.53
760	starch	1.45	1.39	1.34
	Av.	1.30	1.27	1.45

Comparative effects of glucose and starch on gas formation. In the light of Quin's hypothesis and data cited above, it seemed desirable to obtain more information on the effects of glucose and starch on gas formation. The tests were run under two conditions: in the first, the cows were given free access to green alfalfa tops fed in the barn for 4 hours preceding the test period; in the second, the cows were fed 9 lb. of alfalfa hay and 6 lb. of rolled barley 20 hours before the experimental period. Gas production was determined for 1 hour before the experimental period in the first experiment and for 30 minutes in the second. To introduce the test substance, glucose or starch, a rubber tube with a funnel attached to one end was connected to the side arm of the cannula. During the introduction of the test substance, the tube leading from the cannula to the gas meter was clamped off. The solution of starch or glucose was poured into a funnel elevated 3 or 4 feet above the level of the entrance of the cannula into the rumen, the fluid flowing into the rumen by gravity. Five to ten minutes were needed in introducing the solution.

In table 2 is shown the effect of administering starch or glucose to cows fed alfalfa tops for 4 hours preceding the test period. No significant change in the rate of gas formation resulted with either glucose or starch.

The results obtained when the cows were fed 20 hours before the experimental period are given in table 3. The amount of glucose or starch administered was reduced from 2 kg., as in the previous experiment, to 1 kg., because the higher dose of glucose on a partially empty rumen had an adverse effect on the cow, resulting in diarrhea and loss of appetite. Under this regime, 1 kg. of glucose in 3 liters of water increased gas production regularly within the first half hour after its introduction. The response to an equal amount of

TABLE 3

Comparative effects of glucose and starch on ruminal gas formation in cows fed 20 hours before the experimental period. One kg. of starch or glucose in 3 l. of H_2O was administered through a cannula directly into the rumen

Date of trial	Cubic feet of ruminal gas formed:					
	Hour before drench[a]	1st hour after drench	2nd hour after drench	3rd hour after drench	4th hour after drench	Total after drench
			1 kg. glucose administered			
Mar. 11	0.33	0.67	0.68	0.51	0.53	2.39
Mar. 23	0.31	1.11	1.11	0.78	0.76	3.77
Mar. 30	0.42	1.09	0.85	0.85	0.52	3.31
Apr. 13	0.44	1.00	0.96	0.83	0.45	3.24
Av.	0.38	0.97	0.90	0.74	0.57	3.18
			1 kg. starch administered			
Mar. 18	0.56	0.80	0.94	0.84	0.56	3.13
Mar. 25	0.48	0.45	0.62	0.67	0.56	2.29
Apr. 6	0.48	0.43	0.76	0.98	0.81	2.98
Av.	0.51	0.56	0.77	0.83	0.64	2.80

[a] Gas was determined for only 0.5 hr. before drenching. The figure obtained was multiplied by 2 to facilitate comparison of gas production before and after drenching.

starch was not marked until the second hour after drenching, but during the third and fourth hours more gas was liberated than with glucose. The tests on starch and glucose were run for 30 minutes longer than is shown in table 3. During this last half hour, there was an average production of 0.22 cubic feet of gas with glucose and 0.32 cubic feet with starch. Thus the effect of starch is more prolonged and the total gas produced is apparently the same as with glucose.

Studies on Consumption of Alfalfa Pasture

For these studies, the cows were weighed in and out of pasture and during the intervening period all excreta were collected and weighed. The pasturing period extended from 8 a.m. to 2:30 p.m. The studies were made between June 14 and October 10. Insensible losses were determined on 2 days and amounted to approximately 3 lb. per hour, but the insensible losses were not taken into account in calculating feed consumption. On a few occasions, the

insensible losses exceeded feed consumption, thus explaining the apparent negative consumption values shown in figures 1 and 2.

One of the objectives of the experiment was to determine if palatability varied in different fields. Further, it was desired to ascertain the influence of maturity on palatability. Decisive answers were not obtained to either question for reasons which will be explained. The results of the study are summarized in figures 1 and 2.

Figure 1 gives the feed consumption on two different fields, 1-C South and Dairy Field 4. Two lactating cows were used in this part of the study; cow

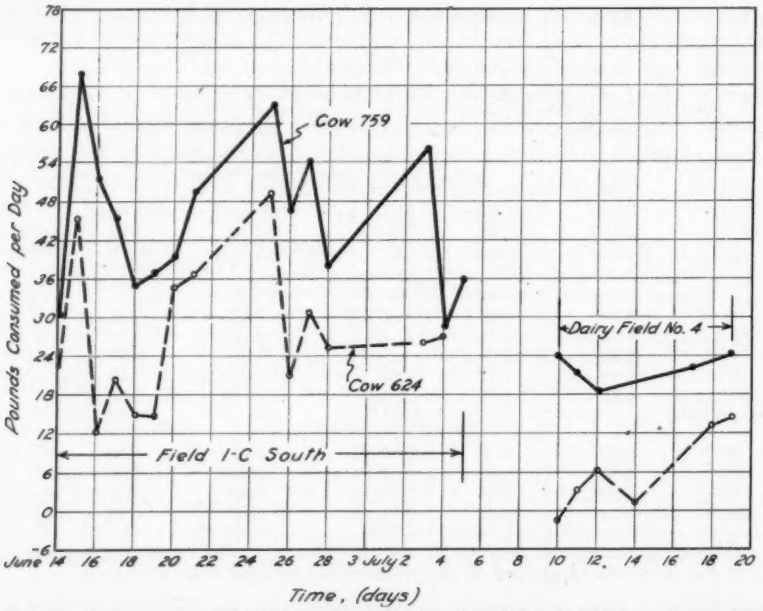

Pounds Consumed per Day
Cow 759
Cow 624
Field 1-C South
Dairy Field No. 4
Time, (days)
June 14 16 18 20 22 24 26 28 3 July 2 4 6 8 10 12 14 16 18 20

FIG. 1. Consumption of alfalfa on fields 1-C South and Dairy Field 4. The cows, 759 and 624, were on pasture for 6.5 hours daily. In determining feed consumption, insensible losses were not considered.

624 received 5 lb. of a concentrate mix at 3 a.m. and 3 p.m. and cow 759 received 7 lb. night and morning. Cow 759 had been shown to be susceptible to bloat in previous studies, whereas cow 624 never had bloated severely, even under conditions in which the majority of the herd had bloated. No hay was fed. The cows were pastured intermittently on 1-C South from June 14 to July 5. There were 12 acres in this field, and thus the amount consumed by the 2 cows had no appreciable influence on the amount of feed available during this period. Although the stand of alfalfa on 1-C South appeared to be fairly clean on cursory examination, there were some weeds and annual grasses on the irrigation checks. When the cows were first put on the field, the alfalfa was about 1 foot tall and very succulent. Furthermore, the alfalfa was relatively

unpalatable and during the first week the cows ate approximately as much weeds and grasses as alfalfa. One cow did not bloat on this field, and the other, cow 759, bloated slightly on 3 different days. We attribute this relative lack of bloat to the consumption of sufficient weeds and grasses to induce belching. In support of this view is the fact that both cows ruminated more than one would expect when pasturing on succulent alfalfa without access to hay. Cows ruminate very little on fields causing severe bloat. Experience in the next field, Dairy Field 4, with the same cows adds weight to this interpretation. This field had been pastured earlier in the season and was devoid of contaminating

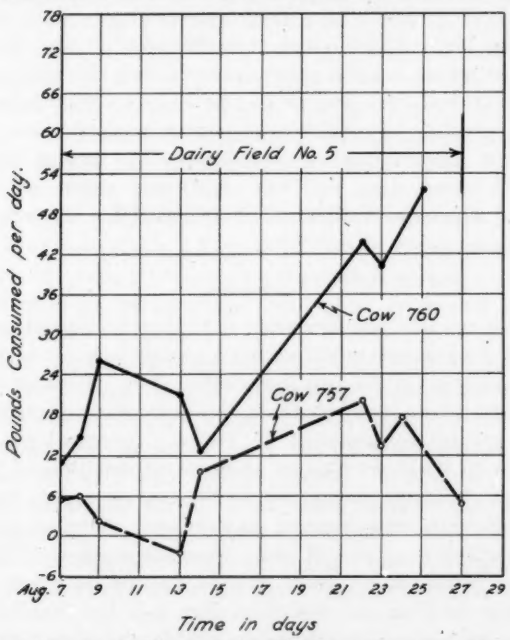


FIG. 2. Consumption of alfalfa on Dairy Field 5. The cows, 760 and 757, were on pasture for 6.5 hours daily. In determining feed consumption, insensible losses were not considered.

weeds and grasses. Cow 624 bloated on 4 of 6 pasturing days on this field, and cow 759 bloated every day—on two occasions the bloat was sufficiently severe to require treatment with turpentine. "Severe bloat" refers to a condition in which there is marked distress, frequent urination and defecation and a ruminal pressure of 45 to 70 mm. Hg (1).

Palatability of the alfalfa on the two fields was considered. Field 1-C South was pastured over a 3-week period during which the alfalfa became progressively more mature. It was in the late bud stage at the termination of the trial. This field was irrigated on June 11. The fact that the cows ate a considerable proportion of weeds, particularly during the first week, presents

some difficulties in interpretation. However, the cows were under constant observation during the pasturing period by the attendants collecting the excreta, and there is little doubt but that the cows ate a greater amount of alfalfa as it became more mature. Furthermore, there is little doubt that the alfalfa in field 1-C South was more palatable than in Dairy Field 4. The results are difficult to evaluate, however, for two reasons: on field 1-C South, the exact consumption of alfalfa is unknown because the cows ate grasses and weeds in addition to alfalfa; secondly, the consumption of alfalfa on Dairy Field 4 was depressed as the result of bloat. In other words, when the cows bloated, they stopped eating.

The results on Dairy Field 5 with cows 760 and 757 are shown in figure 2. Here the evidence seems a little more clear-cut that the alfalfa becomes more palatable as it matures. On August 13 and 14, cow 760 bloated, on the latter date sufficiently severely to require treatment with turpentine. This explains her relatively low consumption on these days. By August 22nd, the alfalfa was in the early bloom stage and was sufficiently coarse to induce frequent rumination. No adequate explanation is available for the relatively low and sporadic feed consumption of cow 757.

DISCUSSION

The results on ruminal gas formation following feeding of green Sudan and alfalfa tops indicate that one might expect a greater amount of gas formed from alfalfa if equal amounts of the two feeds were given. With *ad libitum* feeding, the total gas formed from the two feeds, however, was approximately the same because of the greater consumption of Sudan. Increased gas production on legumes does not in itself provide an adequate explanation of bloat; cows will bloat on amounts of alfalfa comparable to those consumed in these experiments but bloat did not occur when normal animals were given an amount of Sudan producing an equivalent volume of gas. Previous studies (2) have shown that dry legume hay results in as much gas production as green alfalfa. These data give further confirmation, therefore, that it is the inability of animals to eructate the gas on legumes which makes alfalfa and clover dangerous from a standpoint of bloat. Nevertheless, the rapid gas formation on legumes undoubtedly is a contributing factor in bloat.

Quin (5) has compared the rate of gas formation on alfalfa and grass hay. He reports a rapid production of gas on alfalfa hay, a result in accord with our studies (2). On the contrary, he found no gas formed over a 90-minute period in two of three trials with sheep on a basal diet of grass hay. In the light of the data reported herein on a green grass (Sudan), this result needs further confirmation.

When cows were fed 20 hours before the experimental period, glucose caused an earlier increase in gas formation than did starch, but the total gas produced from the two substances over a period of 4.5 hours was about the same. Quin reported that when starch, in the form of maize, was given to sheep maintained on a basal diet of green alfalfa, there was no gas formed over a 90-minute

period. When cows were given a full feed of alfalfa during a 4-hour interval preceding the test period, no difference in gas formation between glucose and starch was observed. Conceivably the sugar content of alfalfa could be a contributing factor in bloat as postulated by Quin, but further studies are necessary to establish the point.

The present studies on palatability of legumes at different stages of maturity were not conclusive but indicated that alfalfa increases in palatability as it matures. Two main difficulties in these studies were encountered: first, cows ate weeds and grasses along with the alfalfa when the fields were contaminated; second, cows on pure alfalfa stands bloated and this in turn depressed feed consumption and made it impossible to obtain a true estimate of palatability. Therefore, it appears that a more desirable procedure would be to cut the alfalfa tops and feed them in the barn. In this way, the weeds and grasses could be avoided. Further, it would appear necessary to supplement the diet with sufficient Sudan grass hay or with green Sudan to obviate bloat.

SUMMARY AND CONCLUSIONS

In an average of four trials, 4.7 cubic feet of gas were produced when cows consumed 47.6 lb. of green Sudan tops fed *ad libitum* over a 4-hour period as compared to 4.3 cubic feet when cows consumed an average of 15.5 lb. of green alfalfa tops over a similar period.

The amount of gas formed following drenching with glucose or starch was determined both by feeding cows 20 hours before the experimental period or feeding them with alfalfa tops *ad libitum* 4 hours preceding drenching. In the former instance, glucose caused a more prompt increase in gas formation, whereas the effect of starch was more prolonged. When cows were fed immediately preceding drenching, on the other hand, no difference between glucose and starch as regards gas formation was discernible.

Studies on the consumption of alfalfa pasture indicate that alfalfa becomes more palatable as it matures up to the early bloom stage, but the results were inconclusive.

REFERENCES

(1) Cole, H. H., and Kleiber, Max. Bloat in Cows on Alfalfa Pasture. Am. J. Vet. Research 6: 188–193. 1945.

(2) Cole, H. H., Mead, S. W., and Kleiber, Max. Bloat in Cattle. Calif. Agr. Expt. Sta. Bull. 662. 1942.

(3) Cole, H. H., Mead, S. W., and Regan, W. M. Production and Prevention of Bloat in Cattle on Alfalfa Pasture. J. Animal Sci. 2: 285–294. 1943.

(4) Jacobson, C. A. Alfalfa Saponin. Alfalfa Investigations VII. Am. Chem. Soc. J., 41: 640–648. 1919.

(5) Quin, J. I. Studies on the Alimentary Tract of Merino Sheep in South Africa. VII. Fermentation in the Forestomachs of Sheep. Onderstepoort J. of Vet. Sci. and Animal Ind., 18: 91–112, 1943.

(6) Quin, J. I. Studies on the Alimentary Tract of Merino Sheep in South Africa. VIII. The Pathogenesis of Acute Tympanites (Bloat). Onderstepoort J. of Vet. Sci. and Animal Ind., 18: 113–117. 1943.

A STUDY OF THE USE OF THE ANTIOXIDANT NORDIHYDROGUAIARETIC ACID IN DAIRY PRODUCTS. II. ITS ANTIOXYGENIC PROPERTIES IN UNSWEETENED FROZEN CREAM[1]

J. W. STULL, E. O. HERREID AND P. H. TRACY
Department of Food Technology, University of Illinois, Urbana

The use of antioxidants in retarding the development of oxidized flavor during the storage of frozen cream has been studied by several investigators (2, 3, 4, 5, 6). The work reported herein consists of a study in which nordihydroguaiaretic acid (NDGA) was used to retard the development of oxidized flavor during the storage of unsweetened frozen cream containing 40 per cent milk fat.[2]

EXPERIMENTAL PROCEDURE

Two grades of cream, one of high and the other of low quality, were used in this study. Standard plate count (1), acidity and pH were the criteria upon which quality was based (table 1).

TABLE 1

The standard plate count, titratable acidity and pH of the raw and pasteurized cream

	High quality		*Low quality*	
	(a)	(b)	(c)	(d)
Raw cream				
Standard plate count	340,000	32,000	345,000,000	6,000,000
Titratable acidity, as % lactic acid	0.120	0.140	0.155	0.125
pH (25° C.)	6.74	6.63	6.50	6.66
Pasteurized cream	*150° F.*	*170° F.*	*150° F.*	*170° F.*
Standard plate count	900	55	2,000	2,860
Titratable acidity, as % lactic acid	0.125	0.135	0.145	0.140
pH (25° C.)	6.62	6.60	6.50	6.39

The different batches of cream were standardized to contain 40 per cent milk fat. NDGA was added after pasteurization as a 10 per cent solution in glycerol or as a 5 per cent water suspension. The concentrations of NDGA were computed on the basis of the fat content of the cream. When used, copper was added at a concentration of 0.5 p.p.m. in the form of a 0.5 per cent aqueous solution of copper sulfate.

The cream was pasteurized in well-tinned equipment, cooled to 40–45° F., sealed in tinned cans holding 300 ml. and stored at –12 to –20° F. For monthly flavor criticisms, the frozen cream was thawed by holding it 24 hours at 40° F.

Received for publication June 23, 1948.

[1] The data contained in this paper are from a thesis submitted by the senior author to the Graduate School of the University of Illinois in partial fulfillment of the requirements for the degree of Master of Science, 1947.

[2] The legality of adding antioxidant material to dairy products would need to be established before its use could be recommended. The authors' interest in the product studied was mainly scientific, although the practicable possibilities of a study of this nature always must be recognized.

TABLE 2

The antioxidant effect of NDGA added to unsweetened cream stored at sub-zero temperatures

Treatment	Flavor criticisms											
	1 mo.		3 mo.		5 mo.		7 mo.		9 mo.		11 mo.	
	(1)[a]	(2)[b]	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Pasteurized at 150° F. for 30 min.												
Series A. Low quality cream.	**No copper added.**											
Control	...[c]	...	...	...	...	...	1[d]	1	1	2	2	4
Control + 0.00125% NDGA	...	...	...	...	...	...	...	...	...	...	...	...
Control + 0.005% NDGA	...	...	...	...	...	...	...	...	...	...	...	...
Series B. Low quality cream.	**0.5 p.p.m. copper added.**											
Control	2	3	3	4	4	5	5[fe]	5[f]	5[f]	5[f]	f	f
Control + 0.00125% NDGA	...	...	1	1	1	1	2	2	4[f]	4[f]	5[f]	5[f]
Control + 0.005% NDGA	...	...	1	1	1	1	2	2	4[f]	4[f]	5[f]	5[f]
Series C. High quality cream.	**No copper added.**											
Control	...	...	...	...	...	1	...	1	...	1	.....	.....
Control + 0.00125% NDGA	...	...	...	...	...	...	...	...	...	...	.....	.....
Control + 0.005% NDGA	...	...	...	...	...	...	...	...	...	...	.....	.....
Series D. High quality cream.	**0.5 p.p.m. copper added.**											
Control	...	2	3	3	4	5	5	5	5	5[f]	.....	.....
Control + 0.00125% NDGA	...	±[f]	...	±	1	1	2	2	2	2	.....	.....
Control + 0.005% NDGA	...	±	...	...	1	1	1	1	...	...	.....	.....
Pasteurized at 170° F. for 15 min.												
Series E. Low quality cream.	**No copper added.**											
Control	...	±	...	±	...	1	...	1	±	1	±	1
Control + 0.00125% NDGA	...	...	...	...	...	...	...	...	...	...	...	...
Control + 0.005% NDGA	...	...	...	...	...	...	...	...	...	...	...	...
Series F. Low quality cream.	**0.5 p.p.m. copper added.**											
Control	...	±	...	±	...	1	...	...	±	±	±	±
Control + 0.00125% NDGA	...	...	...	...	±	±	...	...	...	...	...	...
Control + 0.005% NDGA	...	...	...	...	±	±	...	...	...	...	...	...
Series G. High quality cream.	**No copper added.**											
Control	...	...	...	...	...	...	...	1	...	1	...	1
Control + 0.00125% NDGA	...	...	...	...	...	...	...	...	...	...	...	...
Control + 0.005% NDGA	...	...	...	...	...	...	...	...	...	...	...	...
Series H. High quality cream.	**0.5 p.p.m. copper added.**											
Control	...	...	...	...	1	1	2	3	3	4	3	5
Control + 0.00125% NDGA	...	...	...	...	...	...	...	...	...	...	...	...
Control + 0.005% NDGA	...	...	...	...	...	...	...	...	...	...	...	...

[a] Flavor judged immediately after taking cream out of storage and thawing it.
[b] Flavor judged after thawing cream and then holding it at 40° F. for 1 week.
[c] No oxidized flavor present.
[d] The numbers 1 to 5 indicate increasing levels of oxidized flavor defect.
[e] Fishy flavor.
[f] Flavor slightly 'off.' Not typically oxidized.

It then was held at 40° F. for 1 week after which it was judged again for flavor. The judging panel was composed of three or more persons.

RESULTS

The data in table 2 are typical of results obtained with cream which was placed in storage during the months of August and September. There were no significant differences in the antioxygenic effectiveness of the NDGA when added in glycerol solution and when added in a water suspension. Therefore, the data presented in table 2 includes only results from cream treated with NDGA in glycerol solution.

The effect of concentration of NDGA. A concentration of 0.005 per cent NDGA was more effective than one of 0.00125 per cent. This is demonstrated in the results obtained with the high quality cream which contained added copper and which was pasteurized at 150° F. for 30 minutes (table 2, series D). Oxidized flavor had developed at the end of 3 months storage in the control sample. While this off-flavor had developed at the end of 5 months in the cream treated with both 0.00125 per cent and 0.005 per cent NDGA, the intensity of the off-flavor at the end of 7 months was less in the cream containing 0.005 per cent than in the cream containing 0.00125 per cent NDGA.

The effect of pasteurization temperature. Development of oxidized flavor was retarded by pasteurizing the cream at 170° F. for 15 minutes. Oxidized flavor had developed at the end of 7 months storage in the control sample of series A which was pasteurized at 150° F. for 30 minutes, while it did not develop during storage at sub-zero temperatures in the similar cream pasteurized at 170° F. for 15 minutes. Oxidized flavor was present at the end of 1 month in the control sample of series B which was pasteurized at 150° F. for 30 minutes, whereas it did not develop in the similar cream pasteurized at 170° F. for 15 minutes.

There was no oxidized flavor development during storage for 11 months at sub-zero temperatures in the high quality cream which contained no added copper (table 1, series C and G). The off-flavor was present at 3 months in the control sample of series D which was pasteurized at 150° F. for 30 minutes but was not detected until the end of 5 months in the similar cream pasteurized at 170° F. for 15 minutes. While the keeping quality of the cream pasteurized at 170° F. for 15 minutes was superior to that pasteurized at 150° F. for 30 minutes, it had a cooked flavor which persisted throughout the storage period. The keeping quality of the cream which was pasteurized at 150° F. for 30 minutes and which contained NDGA but no added copper was comparable to that of cream pasteurized at 170° F. for 15 minutes.

The effect of quality of the cream. The cream which was pasteurized at 150° F. for 30 minutes developed the oxidized flavor in the control sample containing added copper (series B) at the end of 1 month, but the off-flavor was not detected in the similar high quality cream until the end of 3 months (series D).

There was no oxidized flavor development in any of the low quality cream pasteurized at 170° F. for 15 minutes during storage for 11 months at sub-zero

temperatures. However, the off-flavor was present at the end of 5 months in the control sample of the similar high quality cream containing added copper (series H).

The effect of quality as indicated in this study was variable. The high quality cream which was pasteurized at 150° F. for 30 minutes had a better keeping quality than the similar low quality cream with respect to the oxidized flavor development. The converse of this was true in the cream which was pasteurized at 170° F. for 15 minutes.

The effect of holding the thawed cream at 40° F. for 1 week. Oxidized flavor developed frequently in the control samples which were held at 40° F. for 1 week, although they did not have the off-flavor when they were taken out of storage. This relationship was illustrated in the control sample of series D pasteurized at 150° F. for 30 minutes which had been stored for 1 month at sub-zero temperatures and did not have the oxidized flavor when first removed from the low temperature storage, but developed it after the sample had been held at 40° F. for 1 week. The same observation was made after 5 months in the control samples of series E and after 7 months in the control samples of series H, both of which were pasteurized at 170° F. for 15 minutes.

After storage for 1 week at 40° F., the oxidized flavor usually increased in intensity in the control samples which had that off-flavor when they were first taken out of storage. This is evident in the cream pasteurized at 150° F. for 30 minutes in the control samples of series A after 9 and 11 months, in series B after 1, 3 and 5 months and in series D after 5 months. This trend also was evident after 7, 9 and 11 months in the control samples of cream in series H which had been pasteurized at 170° F. for 15 minutes. However, the intensity of the oxidized flavor did not increase during storage at 40° F. in the samples which contained NDGA.

CONCLUSIONS

1. Concentrations of 0.00125 to 0.005 per cent nordihydroguaiaretic acid were found to retard the development of oxidized flavor in unsweetened frozen cream during storage for 11 months.

2. In the absence of added copper, the keeping quality of the cream which contained nordihydroguaiaretic acid and was pasteurized at 150° F. for 30 minutes was comparable to that pasteurized at 170° F. for 15 minutes but to which the antioxidant had not been added.

3. In this study, the high quality cream pasteurized at 150° F. for 30 minutes had a better keeping quality than the low quality cream similarly pasteurized. The converse of this was true in the cream which was pasteurized at 170° F. for 15 minutes.

4. During storage for 1 week at 40° F., an oxidized flavor developed frequently in the control samples, although these samples did not have the off-flavor when they were taken out of storage at sub-zero temperatures. This did not occur in the cream which contained nordihydroguaiaretic acid.

5. During storage for 1 week at 40° F., the intensity of the oxidized flavor usually increased in the control samples which had the off-flavor when they were

first taken out of storage at sub-zero temperatures. This did not occur in the oxidized samples which contained nordihydroguaiaretic acid.

REFERENCES

(1) AMERICAN PUBLIC HEALTH ASSOCIATION. Standard Methods for the Examination of Dairy Products. 8th Ed. Am. Pub. Health Assoc., New York. Pp. 7–40. 1941.

(2) BARNHART, J. L. Factors Affecting the Stability of Butterfat in Frozen Cream. Thesis in the Graduate School, Penn. State College. 1940. (Cited from J. Dairy Sci., 24: 245–265. 1941.)

(3) DAHLE, C. D., AND JOSEPHSON, D. V. An Antioxidant for Ice Cream. Ice Cream Field, 31: 1, 15–16, 40–41. 1937.

(4) LAWHORN, R. K. Factors Affecting the Keeping Quality of Frozen Cream. Thesis in the Graduate School, Penn. State College. 1939. (Cited from J. Dairy Sci., 24: 245–265. 1941.)

(5) STULL, J. W., HERREID, E. O., AND TRACY, P. H. A Study of the Use of Nordihydroguaiaretic Acid in the Storage of Frozen Sweet Cream. J. Dairy Sci., 30: 541. 1947.

(6) TRACY, P. H., HOSKISSON, W. A., AND TRIMBLE, J. M. Wheat Germ Oil as an Antioxidant in Dairy Products. J. Dairy Sci., 27: 311–319. 1944.

THE RELATION BETWEEN THE MONTH OF CALVING AND YEARLY BUTTERFAT PRODUCTION[1]

MOHAMED M. OLOUFA AND I. R. JONES
Department of Dairy Husbandry, Oregon State College, Corvallis

Approximately 71 per cent of the dairy cows of Oregon are located west of the Cascade Mountains; and about two-thirds of these, or 46 per cent of the total, are found on farms in the ten Willamette Valley counties, a region with an average temperature of 52° F. and a monthly mean range from a high of 65° F. in July to 38° F. in December. The average rainfall of about 42 inches comes mostly during the winter months. Since the climate under these conditions is mild and does not show large seasonal variations in comparison with some other parts of the United States, it became of interest to study the effect of the month of calving on butterfat production.

Differences in yearly milk production between cows freshening in the different months of the year, in various parts of the United States, have been found to exist (1, 2, 5, 7, 8). The season of the year in which the cow freshens also was reported to exert an effect on her butterfat production (1, 4, 8). In Connecticut, Frick *et al.* (2) found that the differences in milk production of cows calving in the different months of the year were highly significant statistically.

PROCEDURE

Data for the present study were obtained from the record books of the dairy herd owned by Oregon State College and from official test records of cows tested in Oregon covering the years 1910 through 1946. Only first-calf, 2-year old records were used. The official records of butterfat production were tabulated separately for cows milked twice a day during 305-day and 365-day lactations. Production of cows milked three times daily, part or all of the milking period, was reduced to a 2-times a day milking basis by using the factor 0.0655 of 1 per cent for each day the cow was milked 3 times. The distribution of the 2690 records between breeds was 1881 Jerseys, 358 Guernseys, 301 Holstein-Friesians and 150 Ayrshires. The number of records available from the College herd was 359, while 2331 were from private herds.

An analysis of variance (6) was applied to the data to find out the significance of the difference in butterfat production of cows calving each month of the year.

RESULTS AND DISCUSSION

Information on the butterfat records of first calf heifers used in the study is given in table 1.

Table 2 gives a summary of the results of the statistical analysis of the data. The variations in butterfat production among cows freshening within each month

Received for publication June 28, 1948.

[1]Published as Technical Paper No. 538 with the approval of the Director of the Oregon Experiment Station. Contribution of the Department of Dairy Husbandry.

TABLE 1

Average yearly butterfat production of five groups of first calf heifers

Month of freshening	Group 1[a]		Group 2		Group 3		Group 4		Group 5	
	No. of heifers	Av. prod.	No. of heifers	Av. prod.	No. of heifers	Av. prod.	No. of heifers	Av. prod.	No. of heifers	Av. prod.
		(*lb.*)		(*lb.*)		(*lb.*)		(*lb.*)		(*lb.*)
January	80	455	34	372	66	488	19	483	42	320
February	78	464	38	390	68	489	23	479	28	295
March	91	469	32	375	64	474	20	477	24	330
April	102	421	26	379	76	473	11	467	25	304
May	72	425	27	380	81	464	13	479	27	372
June	53	438	18	359	62	465	10	458	19	326
July	48	434	26	338	47	458	18	471	22	326
August	69	459	19	384	78	482	23	467	33	322
September	104	446	19	397	105	466	35	472	49	312
October	70	444	25	398	84	450	24	470	29	341
November	64	461	25	389	69	484	9	459	31	329
December	78	445	29	387	72	498	27	474	30	305
Total & mean	909	447	318	379	872	474	232	473	359	323

[a] Group 1. Jersey, 305 day, Register of Merit
Group 2. Guernsey, Holstein, Ayrshire, 305 day, Advanced Registry
Group 3. Jersey, 365 day, Register of Merit
Group 4. Guernsey and Holstein, 365 day, Advanced Registry
Group 5. Ayrshire, Guernsey, Holstein and Jersey herd test (college)

were large, and a definite trend was not followed when the monthly averages were studied, but rather an up-and-down line. Jersey cows milked for 305 days were

TABLE 2

Analysis of variance of the butterfat records used in the study

Group	Source of variation	Degrees of freedom	Sum of squares	Variance	Variance ratio	Significance level 5%	Significance level 1%
1 Jersey R. of M. 305 days	Month	11	209,932.14	19,084.74	2.25	1.80	2.26
	Error	897	7,594,314.99	8,466.35			
	Total	908	7,804,247.13				
2 Guernsey Holstein Ayrshire A.R. 305 days	Month	11	77,933.46	7,084.86	1.45	1.82	2.31
	Error	306	1,496,925.13	4,891.91			
	Total	317	1,574,858.59				
3 Jersey R. of M. 365 days	Month	11	160,275.05	14,570.46	1.02	1.80	2.26
	Error	360	12,275,470.21	14,273.80			
	Total	871	12,435,745.26				
4 Guernsey Holstein A.R. 365 days	Month	11	8,700.71	790.97	0.09	1.83	2.34
	Error	220	2,009,556.38	9,134.35			
	Total	231	2,018,257.09				
5 All breeds College Herd Test	Month	11	124,238.84	11,294.44	1.71	1.81	2.29
	Error	347	2,297,328.15	6,620.54			
	Total	358	2,421,566.99				

the only group that showed significance at the 5 per cent level, although not significant at the 1 per cent level. Since the other four groups showed insignificant differences between the production of cows freshening in different months of the year, the significance of the first group is of doubtful value.

SUMMARY

The butterfat records of 2690 first-calf heifers in herds located in western Oregon, a region with rather uniformly mild temperature, were studied to determine the effect of the month of calving on yearly butterfat production.

It seems that under western Oregon conditions the season of the year in which a cow freshens has no appreciable effect on her yearly butterfat production.

REFERENCES

(1) Cannon, C. Y. Seasonal Effect on Yield of Dairy Cows. J. Dairy Sci., 16: 11. 1933.
(2) Frick, G. E., Mann, A. I., and Johnson, S. The relation of Season of Freshening to Milk Production. J. Dairy Sci., 30: 631–640. 1947.
(3) Kendrick, J. F. Proving Dairy Sires. U. S. Dept. Agr., B.D.I.M. 623, Rev. 1935.
(4) McDowell, J. C. Influence of Season of Freshening on Production and Income of Dairy Cows. U. S. Dept. Agr. Bull. 1071. 1922.
(5) Morrow, K. S., Keener, H. A., and Hall, C. N. Analysis of Certain Factors Involved in Dairy Herd Management in New Hampshire. N. H. Agr. Expt. Sta. Tech. Bull. 86. 1945.
(6) Snedecor, G. W. Statistical Methods, 4th Ed. The Iowa State College Press, Ames. 1946.
(7) Woodward, T. W. Some Studies of Lactation Records. J. Dairy Sci., 28: 209–218. 1945.
(8) Wylie, C. E. The Effect of Season on the Milk and Fat Production of Jersey Cows. J. Dairy Sci., 8: 127. 1925.
(9) Yearbook of Agriculture. Climate and Man. P. 1075. U. S. Dept. Agr. 1941.

SOME FACTORS INFLUENCING THE MALE HORMONE CONTENT OF COW MANURE[1]

C. W. TURNER

Department of Dairy Husbandry, University of Missouri, Columbia

Riley and Hammond (8) discovered that the feeding of dried cow manure to day-old chicks caused marked stimulation of the comb growth. Evidence was presented indicating that the factor present was an androgenic rather than a gonadotrophic substance. They reported that "feces from bulls were entirely without effect, whereas feces from pregnant cows, as well as from unbred heifers, had marked androgenic effects."

Turner (10, 11, 12) confirmed the report of the presence of orally-active androgens in the feces of lactating cows when dried at 45° C. The androgen content of the manure of other ruminants, including goats and sheep of both sexes and conditions, was either low or absent. The feces of dairy bulls showed indications of only small androgen excretion by that route.

Gassner and Longwell (1, 4) reported that the concentration of androgens in feces reached a peak during the last week of pregnancy and then dropped sharply to zero at calving. Steer and bull manures were relatively inactive biologically.

The present studies were initiated to throw further light upon the functional relationship between the male hormone eliminated in the feces of dairy cows of the several breeds and reproduction and lactation. Further, in connection with studies concerned with the characterization of the androgens excreted and with methods for their extraction, it was considered helpful to know when the greatest concentration of hormone might be expected.

EXPERIMENTAL PROCEDURE

The fresh manure was collected from individual cows of the Guernsey, Holstein and Jersey breeds in the University of Missouri dairy herd. Complete samples were not collected, rather the feces dropped during the milking period in the morning or afternoon were combined until a sufficient quality was collected for an assay. This usually required 2 to 3 days. Cows in various stages of lactation and pregnancy were included. When a series of samples from the same cow was collected, at least a month intervened between samples. Each collection of fresh manure was placed quickly in a Freas electric drying oven maintained at a temperature of 45° C. Samples were stirred daily. At least 48 hours were required to dry the collection. The dried manure was placed in a large lard can and, when collection was complete, the entire sample was ground in a small hammer mill and thoroughly mixed before assay.

The androgen content of each sample was assayed biologically by the method

Received for publication July 19, 1948

[1] Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 1120.

previously described (12). Groups of about 20 sexed White Plymouth Rock chicks were used throughout and the dried cow manure was fed uniformly at the 10 per cent level by substituting the dried manure for an equal weight of alfalfa meal in the basal chick starter ration. These assays were conducted monthly throughout the year.

Each month a group of control chicks and a group fed methyl testosterone at the rate of 20 mg./kg. of feed were included to determine the possible seasonal variation in the responsiveness of the chick comb to androgen. Since no seasonal trend was observed in the average comb weight of either sex in the control group or those fed methyl testosterone, it was decided that no correction factor for season was required (13).

As a measure of the presence of biologically active androgens in the samples, the average comb weight per 100 g. body weight of each sex was determined. The average comb weights per 100 g. body weight for the two sexes were added together and divided by two. This value should represent the average comb weight per 100 g. body weight of a population of chicks containing equal numbers of the two sexes.

As a measure of the biological activity of the male hormone present in the various samples of dried cow manure, comparison may be made with the average comb weight of groups of control chicks of the same age and with groups of chicks fed 10 and 20 mg. of methyl testosterone per kilogram of starter feed. Since the biologically active androgenic hormones present in cow manure are not known, it seems preferable to indicate differences in the various samples in terms of average comb weight rather than in terms of any single androgen. For a comparison of the oral effectiveness of several androgens in fowls the reader is referred to a paper by the writer (14). The average comb weight of all the chicks fed samples of dried cow manure assayed in this study is presented for comparison (table 1).

RESULTS

Effect of pregnancy upon androgen excretion. In the dairy cows available for our study, no clear-cut separation of pregnancy and lactation could be made, since the heifers pregnant for the first time were not stabled. The group of cows included in table 2 were all lactating cows, but they were classified on the basis of the month of pregnancy. Since lactating cows are not bred until 90 days or more after parturition, the group of cows whose manure was assayed during the first month of pregnancy included cows lactating an average of 124 days. By the eighth month of pregnancy, most of the cows had been dried up; only two of eight cows still were lactating slightly. The cows in the ninth month of pregnancy all were dry.

It will be seen that, aside from the second month, the assay results did not vary greatly from month to month until the eighth and ninth months of pregnancy. Apparently there is a tendency for the male hormone excretion rate to increase at the approach of parturition. This rise occurred at a time when the cows were either dry or almost dry.

TABLE 1

Comparison of comb weight of chicks fed control feed, methyl testosterone and cow manure

Treatment	Male chicks					Female chicks					Male + female / 2	
	No. of chicks	Av. body weight	Av. testes weight	Av. comb weight	Comb weight / 100 g. body wt.	No. of chicks	Av. body weight	Av. ovary weight	Av. comb weight	Comb weight / 100 g. body wt.	comb weight / 100 g. body wt.	Ratio of control group
		(*g.*)	(*mg.*)	(*mg.*)	(*mg.*)		(*g.*)	(*mg.*)	(*mg.*)	(*mg.*)	(*mg.*)	
Control	185	242.4	48.88	102.69	42.37	199	224.8	48.61	51.17	22.76	32.59	1:
10 mg. MT[a]/kg.	52	248.4	42.86	240.80	96.94	46	236.3	45.45	246.20	104.18	100.56	3.09
20 mg. MT[a]/kg.	157	239.2	43.61	360.50	150.74	158	226.2	49.78	252.67	111.70	131.22	4.03
10% cow manure	872	251.8	31.47	202.25	80.31	855	236.1	38.10	137.66	58.31	69.31	2.13

[a] MT = Methyl Testosterone

TABLE 2

Effect of the stage of pregnancy upon the androgen excretion of dairy cattle (assay with white rock chicks—28 days of age)

Month of pregnancy	Lactation days. av.	No. of cows (breed)[a]	Male Chicks					Female Chicks					Male + female / 2
			No. of chicks	Av. body weight	Av. testes weight	Av. comb weight	Comb weight / 100 g. body wt.	No. of chicks	Av. body weight	Av. ovary weight	Av. comb weight	Comb weight / 100 g. body weight	comb weight / 100 g. body weight
				(*g.*)	(*mg.*)	(*mg.*)	(*mg.*)		(*g.*)	(*mg.*)	(*mg.*)	(*mg.*)	(*mg.*)
1	124	3(2H, 1J)	32	235.1	28.85	147.24	62.63	43	232.6	33.74	106.19	45.65	54.14
2	169	7(5H, 1G, 1J)	64	248.9	29.93	233.48	93.80	67	236.3	38.87	195.93	82.92	88.36
3	180	6(5H, 1J)	69	243.4	32.95	175.53	72.12	48	224.2	51.14	137.18	61.19	66.66
4	216	4(4H)	34	257.4	37.72	153.73	59.72	46	243.9	45.25	111.33	45.65	52.69
5	284	5(2H, 3G)	56	266.1	40.10	161.61	60.73	47	242.2	46.67	102.10	42.16	51.44
6	286	5(2H, 3J)	49	260.5	33.30	210.05	80.63	51	236.6	66.09	124.19	52.49	66.56
7	294	3(2H, 1J)	29	248.0	28.47	148.70	59.96	29	243.6	39.90	142.10	58.33	59.15
8	Almost dry	8(5H, 1G, 2J)	73	234.1	28.45	281.66	120.32	83	224.2	40.41	190.05	84.78	102.55
9	Dry	7(4H, 3J)	73	272.4	32.12	256.81	94.27	69	252.2	37.88	169.31	67.13	80.70
Non-pregnant, dry cows		4(1H, 3J)	33	252.6	28.15	205.81	81.48	43	253.3	38.93	168.53	66.53	74.01
Breed													
Holstein		22	226	249.0	32.04	164.63	66.12	219	235.4	43.52	126.40	53.70	59.91
Guernsey		4	49	267.6	37.68	202.67	75.74	38	250.5	45.61	123.66	49.36	62.55
Jersey		7	58	249.4	27.03	233.96	93.81	74	233.6	54.36	165.85	70.99	82.40

[a] H = Holstein, G = Guernsey and J = Jersey.

Whether the apparent high level of androgen excretion during the second month is significant is not clear. One of the Holstein cows appeared to excrete an unduly large amount of androgens at this time in comparison with her other assays. Furthermore, since the tabulation according to the stage of lactation shows no similar increase, the writer prefers to believe that this does not represent a general increased level of androgen excretion.

In order to interpret the fluctuation in the androgen excretion rate from month to month during pregnancy due to possible breed variation, the data were classified on the basis of the breed for the first 7 months of pregnancy. The eighth and ninth months were excluded due to possible effect of the preparturient rise in the androgens. This tabulation indicates little difference in the excretion of androgens by Holstein and Guernsey cows, but the Jersey cows appear to excrete greater quantities of androgens under similar conditions.

A small group of non-pregnant dry cows also is included. The relatively higher androgen excretion rate by this group, as compared to the pregnant group, is believed to be due to the presence of a predominant number of Jersey heifers. It would appear that neither pregnancy nor lactation is necessary for the excretion of relatively large amounts of androgens. This confirms the report of Riley and Hammond (8).

Effect of lactation upon androgen excretion. The data on the individual cows were tabulated according to the stage of lactation (table 3). It will be seen that no trend in the average comb weight with the advance of lactation is present during the first 8 months. Comb weight values above normal in the ninth and eleventh months of lactation are interpreted as indications of the prepartum rise in androgen excretion rather than relationship to the advance in the period of lactation.

The tabulation of the data by breeds, up to the time of the preparturient rise, again indicated little difference in the androgen excretion by Holstein and Guernsey cows. The Jersey cows, however, again were higher but not quite as high as in the tabulation of pregnant animals.

DISCUSSION

While the data are limited, they indicate that a relatively high average level of androgen excretion occurs in unbred heifers and non-pregnant, non-lactating cows. Since this observation is in agreement with that of Riley and Hammond (8), it would appear that this hormone is excreted at relatively high levels in sexually mature heifers without reference to pregnancy. Whether there is a cyclic variation in the androgens in relation to the period of heat in heifers has not been investigated. Since there is much experimental work indicating that androgens can stimulate the growth of the mammary duct system, the cyclic growth of the pubertal duct system of heifers may be due, in part, to the presence of androgens as well as estrogens in the blood at this time.

Following conception, the rate of androgen excretion is not believed to increase markedly. It is true that these data show a high level during the second month of pregnancy with a reduction until the seventh month. Further data

TABLE 3

Effect of the stage of lactation upon the androgen excretion of dairy cattle (assay with white rock chicks—28 days of age)

Month of lactation	Stage of pregnancy av.	No. of cows (breed[a])	Female Chicks					Male Chicks					Male + female / 2
			No. of chicks	Av. body weight	Av. testes weight	Av. comb weight	Comb weight / 100 g. body wt.	No. of chicks	Av. body weight	Av. ovary weight	Av. comb weight	weight Comb / 100 g. body weight	comb weight / 100 g. body wt.
				(*g.*)	(*mg.*)	(*mg.*)	(*mg.*)		(*g.*)	(*mg.*)	(*mg.*)	(*mg.*)	(*mg.*)
1	open	8(6H, 1G, 1J)	86	263.2	33.48	205.85	78.21	72	234.6	44.21	127.46	54.33	66.27
2	open	8(3H, 1G, 4J)	73	238.2	30.36	151.05	63.41	70	230.8	46.40	93.05	40.32	51.87
3	3 open 2 bred	5(4H, 1J)	52	261.7	32.56	206.27	78.82	51	251.1	47.25	128.58	51.21	65.02
4	3 open 2–29 days	6(3H, 1G, 2J)	54	262.5	30.55	205.68	78.35	62	234.2	37.05	149.69	63.92	71.14
5	4 open 2–31 days	6(5H, 1G)	74	256.1	36.87	204.55	79.87	50	238.8	47.73	133.99	56.11	67.99
6	1 open 5–67 days	6(4H, 1G, 1J)	61	249.6	31.86	206.65	82.79	58	220.5	49.40	134.94	61.20	72.00
7	2 open 2–76 days	4(4H)	33	269.3	40.75	183.79	68.25	45	239.3	41.58	117.17	48.96	58.61
8	116	6(4H, 1G, 1J)	59	257.1	35.76	179.51	69.82	58	234.8	50.93	93.19	39.69	54.76
9	137	7(4H, 1G, 2J)	70	233.3	28.92	215.99	92.58	67	235.1	39.98	173.83	73.94	83.26
10	164	3(1H, 1G, 1J)	31	267.3	36.03	178.73	66.86	30	244.4	43.26	127.50	52.17	59.52
11	217	4(3H, 1G)	44	256.3	28.10	324.40	126.41	30	232.0	34.68	286.09	123.30	124.85
Breed													
Jersey	all	33	374	251.6	34.62	184.49	73.33	364	236.1	50.68	126.34	53.51	63.42
Holstein	all	6	93	269.3	34.67	200.47	74.44	76	247.7	44.17	110.01	44.41	59.43
Guernsey	all	10	167	255.3	28.93	212.65	83.29	166	234.9	41.44	139.72	59.46	71.39

[a] H = Holstein, G = Guernsey and J = Jersey

will be required to indicate whether the rise during the second month is significant. Until that time, it seems preferable to believe that early pregnancy is not a period of increased androgen excretion.

It is well known that the first half to two-thirds of pregnancy is a period of rapid duct and lobule-alveolar growth of the udder. This growth is stimulated by the hormone of the corpus luteum, called progesterone, acting upon the anterior pituitary thus stimulating the secretion of the mammogenic hormone. It has been proved that the estrogenic hormones augment the action of progesterone and mammogen. It also has been shown that certain androgenic hormone derivatives can stimulate slight lobule-alveolar mammary growth (7). The fact that the androgenic hormones are not excreted in increased amounts during the first two-thirds of pregnancy suggests that they do not play a predominant role in the great growth of the udder at this time. They may supplement the progesterone and balance physiologically the increasing secretion of estrogen.

The most striking change in the androgen excretion rate occurs during the period preceding parturition. It is well known that the excretion of estrogen both in the urine (15) and feces (2) increases rapidly at the approach of calving in dairy cattle. It is possible that the rise in androgen excretion at this time indicates a mechanism designed to counter-balance or offset, in part, the physiological effect of the rapidly rising prepartum estrogen secretion. It is believed that the secretion of progesterone may decline at this time, thus permitting estrogen to become predominant and to initiate parturition and, by stimulation of the pituitary, to increase the secretion of the lactogenic hormone (5, 6).

Since estrogen has been shown to stimulate the secretion of adrenocorticotrophic hormone by the pituitary, there would be expected increased gluconeogenesis of protein and resultant loss of nitrogen in the urine due to the hormones of the adrenals (3, 9). The androgens are known to have the opposite effect, increasing the retention of nitrogen and body growth by reduction of the secretion of the adrenal cortical hormones (16).

The concurrent rise in both estrogen and androgen during late pregnancy may indicate the presence of an adaptive mechanism of the body by which certain effects of one hormone can be balanced by the opposite effects of the other yet permitting necessary stimulation to prevail, *i.e.*, the estrogen stimulation of the lactogenic hormone.

The rise in androgen secretion at the approach of parturition suggests the need of further study of the relation of estrogen to androgen in the stimulation of the lactogenic hormone. It has been shown that androgenic hormones are capable of stimulating an increase in the lactogenic hormone of the pituitary (5). Does the androgen secreted prepartum supplement estrogen in the stimulation of the lactogenic hormone?

Since the level of excretion of androgenic hormones during most of lactation is rather uniform, there is no reason to believe that the androgens play a dynamic role in the maintenance of milk secretion.

SUMMARY AND CONCLUSIONS

1. Manure from cows of the Guernsey, Holstein and Jersey breeds during various physiological states has been dried at 45° C. and assayed biologically for its content of male (androgenic) hormone.

2. It was observed that sexually mature non-pregnant heifers excrete male hormone at a level comparable to those of mature cows.

3. During the first two-thirds of pregnancy, no tendency for a rise in androgen excretion was observed. There was evidence of a preparturient rise in androgens.

4. With the advance of lactation, no change in androgen excretion was noted except when associated with the approach of the subsequent parturition.

5. Dried cow manure from the Guernsey and Holstein breeds appeared comparable in biological activity; the Jersey cows appeared to excrete slightly more male hormone.

6. It is suggested that the preparturient rise in androgen may be related to the marked rise in estrogen at the same time.

7. It is possible that androgens as well as estrogens play roles in the stimulation of the secretion of the lactogenic hormone by the pituitary at the time of parturition.

The author is indebted to Mr. A. J. Olson for his aid in the collection and drying of the samples and for the care of the chicks during the period of assay of the male hormone.

REFERENCES

(1) Gassner, F. X., and Longwell, B. B. Fecal Excretion of Androgens by the Dairy Cow During Pregnancy. Federation Proc., 6: 109. 1947.

(2) Levin, L. The Fecal Excretion of Estrogens by Pregnant Cows. J. Biol. Chem., 157: 407. 1945.

(3) Long, C. N. H., Katzin, B., and Fry, E. G. The Adrenal Cortex and Carbohydrate Metabolism. Endocrinology, 26: 309. 1940.

(4) Longwell, B. B., and Gassner, F. X. The Fecal Excretion of Androgens by the Pregnant Cow. Federation Proc., 6: 272. 1947.

(5) Meites, J., and Turner, C. W. Studies Concerning the Induction and Maintenance of Lactation. I. Mechanisms Controlling the Initiation of Lactation at Parturition. Mo. Agr. Expt. Sta. Research Bull. 415. 1948.

(6) Meites, J., and Turner, C. W. II. The Normal Maintenance and Experimental Inhibition and Augmentation of Lactation. Mo. Agr. Expt. Sta. Research Bull. 416. 1948.

(7) Mixner, J. P., and Turner, C. W. The Mammogenic Hormones of the Anterior Pituitary. II. The Lobule-alveolar Growth Factor. Mo. Agr. Expt. Sta. Research Bull. 378. 1943.

(8) Riley, G. M., and Hammond, J. C. An Androgenic Substance in Feces from Cattle as Demonstrated by Tests on the Chick. Endocrinology, 31: 653. 1942.

(9) Tepperman, J., Engel, F. L., and Long, C. N. H. A Review of Adrenal Cortical Hypertrophy. Endocrinology, 32: 373. 1943.

(10) Turner, C. W. Elimination of the Male Hormone by Lactating Dairy Cows. J. Dairy Sci., 29: 525. 1946.

(11) Turner, C. W. The Androgenic (male) Hormone Content of Dairy Cattle Manure. J. Animal Sci., 5: 400. 1946.

(12) TURNER, C. W. The Male Hormone Content of Ruminant Manure. J. Dairy Sci., 30: 1. 1947.
(13) TURNER, C. W. Influence of Season on Comb Development of Chicks Following Oral Administration of Methyl Testosterone. Poultry Sci., 27: 553. 1948.
(14) TURNER, C. W. Oral Effectiveness of Androgens in Fowls. Poultry Sci. (in press)
(15) TURNER, C. W., FRANK, A. H., LOMAS, C. H., AND NIBLER, C. W. A Study of the Estrus Producing Hormone in the Urine of Cattle During Pregnancy. Mo. Agr. Expt. Sta. Research Bull. 150. 1930.
(16) VENNING, E. H., AND BROWNE, J. S. L. Effect of Testosterone on the Excretion of Glycogenic Corticoids. J. Clin. Endocrinol., 7: 729. 1947.

THE INFLUENCE OF THE RATION AND RUMEN INOCULATION ON THE ESTABLISHMENT OF CERTAIN MICROORGANISMS IN THE RUMENS OF YOUNG CALVES[1]

W. D. POUNDEN AND J. W. HIBBS
Ohio Agricultural Experiment Station, Wooster

INTRODUCTION

Previous investigations concerning the etiology of digestive disturbances in young calves included a study of the microorganisms which appeared in their rumino-reticular cavities (7). It was observed at that time that rumen fauna and certain characteristic flora similar to those seen in samples from mature animals were not established in the majority of the calves examined until they were several weeks old. Upon direct inoculation of organisms from cows into the rumens of a few calves, the organisms became established in some of them. These calves, which were on various rations, were among those in the herd at that time which progressed most satisfactorily, but proper controls were not included. The investigations were continued for the purpose of attempting to determine if there was any material advantage in stimulating the development in calves of early rumen activity comparable to mature animals.

Limited studies with a few young calves indicated that certain microorganisms characteristic of the rumen flora and fauna failed to become established regardless of how often inoculations were made when most of the dry feed ingested was grain. It generally was possible, on the other hand, to establish these particular rumen microorganisms in calves even before they were a week old, provided they were ingesting good quality hay and no grain. Variations in ruman flora which were related to the feed ingested have been reported for sheep by Elsden (4), who also cited van der Wath's findings on the same subject. Phillipson (6) also makes reference to this variability of the flora associated with ration differences. It would be expected that a similar situation would exist as regards young calves.

As a result of the preliminary investigations, it was decided to place 4-day-old calves on various systems of feeding, both with and without rumen inoculations, in order to study further the significance of the previous observations. Clinical studies and repeated examinations of the rumen flora and fauna were carried out on these calves during their first 6 weeks of age. Blood plasma vitamin A, carotene and ascorbic acid determinations were made at frequent intervals on many of the calves used in this experiment. The results are reported elsewhere (5).

METHODS

Young calves of both the Jersey and Holstein breeds which had received colostrum usually for 3 days were placed on twice-a-day pail feeding of pasteur-

Received for publication August 3, 1948.

[1] Journal article no. 28–48, Ohio Agricultural Experiment Station. Published with the approval of the Associate Director of the Ohio Agricultural Experiment Station.

ized milk between their second and fourth days of age. They were fed at the daily rate of approximately 0.9 lb. for each 10 lb. of body weight at birth, but within the limits of a minimum of 5 lb. and a maximum of 10 lb. per day. It was hoped to encourage the consumption of dry feeds at an early age by limiting milk consumption to this comparatively low amount. They were treated variously as regards the dry feeds given them. Calves which received hay had access to it while with their dams or were provided on their first day of age with 1 lb. of green alfalfa hay which occasionally had some grasses mixed in it. This was replenished or replaced frequently so that the calves had fresh hay before them at all times. Grain, when included in the ration, was fed once per day as long as the quantities did not exceed 0.5 lb. per day. It consisted of a 14 per cent protein herd mixture of corn, oats, wheat bran and soybean oil meal.

Rumen inoculations were given to some of the calves by passing pieces of freshly obtained cuds from cows into the posterior of the calves' mouths. The cows were being fed alfalfa hay, grain and silage. The inoculations generally were carried out on the fifth, tenth, fifteenth and twenty-first days of age. Samples were obtained from the fore-stomachs of the calves with stomach tubes, using the syphoning method developed for use with the Colorado rumen lavage tube, and, in some instances, samples were taken at the time of slaughter. No difference as regards flora and fauna was observed in samples obtained from the same calves by the two methods.

Calves which did not receive rumen inoculations were cared for by the same personnel as the others and were housed in the same buildings. However, they were separated from direct contact with the other calves and mature animals by partitions and passageways. A limited effort was made to avoid transferring organisms from one calf to another on milk buckets and other equipment.

The rumen samples were examined under the microscope in the fresh condition, using slides and cover glasses, for the purpose of observing the protozoa. For the most part, Gram stained smears were relied upon for bacteriological purposes. In preparing the slides, some of the thick soupy materials containing particles of feed were included, since Baker (2) has shown that some varieties of bacteria tend to remain rather closely attached to feed particles and may not always be readily visible in the free liquid. Descriptions of microorganisms based on morphological and staining characteristics leave much to be desired. However, this method was considered the most advantageous to use for evaluating rumen bacteriological activity under the conditions of this investigation.

RESULTS

The Microorganisms

The protozoa encountered in the rumen samples from the calves appeared to be similar to those mentioned by others, including several investigators whose observations were cited by Baker and Harriss (3) in their recent review article. All those commonly seen in samples from cows were established readily upon

inoculation into calves which were ingesting suitable feeds including hay and hay-plus-grain rations.

Many bacteria differing in morphology and staining characteristics were visible in the rumen samples. Many of them have been described previously by others including Baker (1, 2) and Baker and Harriss (3). Some varieties of organisms were observed to be noticeably present only when appreciable quantities of hay were being consumed and certain other varieties when grain was the principal dry feed ingested. This does not mean that these particular organisms alone were present under such conditions, but merely that they at least were readily visible in the smears. However, when the proportion of grain consumed was high, a few varieties of organisms including those described herein sometimes would appear to make up the majority of the bacterial population. Proof neither was sought nor obtained that the organisms mentioned were the most important ones in the digestion of the feeds present. They were used in this study

TABLE 1

Classification and description of some calf rumen flora observed to vary with the type of feed eaten

Hay Flora[a]	
Group I	Quite large G+ coccoids in closely knit pairs
Group II	Large G+, thick, fairly square-ended rods
	Very large G– cigar-shaped rods
	Smaller G– short rods in fours and multiples of 4
Grain Flora[a]	
Group I	Medium-sized, comparatively thin, G+ rods (sometimes granular stain and variable length)
Group II	G– rods resembling coliform

[a] Flora which appeared to be characteristically associated with the ingestion of these feeds.

as indicators of the presence or absence of characteristic bacterial populations. As reported elsewhere, further studies showed that the same organisms possibly might be used as indicators, within certain limits, of the relative ratios of grain and hay being ingested by young calves (8).

It was possible to subdivide the varieties of the organisms which were noticed to be associated with hay consumption into two sub-groups (table 1). The first consisted of large Gram-positive coccus organisms in closely knit pairs and sometimes in groups of four or more, but not in chain formations. The approximate size of the pairs was 2.8×2.3 microns, and some groups composed of more than a single pair were as much as 4.4×4.0 microns. They possibly were similar to those called large sarcina packets by Baker (1). Among the organisms included in the second hay sub-group were large Gram-positive, thick, rather square-ended rods whose length varied between 3.2 and 5.5 microns and which were approximately 2.5 microns wide. They were observed quite frequently in pairs. Gram-negative, extremely large, cigar-shaped organisms, which often were as much as 21.5 microns long and approximately 4.0 microns wide, also were included in this sub-group. It is probable that these latter organisms are similar to those referred to by others as giant elipsoidal forms (3) or Ocillospira (1, 2). Besides

these, in this group were Gram-negative rods of approximately 1.0×0.8 microns in size that tended to group in fours and multiples of four in shapes suggestive of window panes.

Organisms associated with grain consumption also could be sub-divided into two groups (table 1). The first consisted of Gram-positive rods which ranged between 1.7 and 3.4 microns in length and were approximately 0.8 microns in width. They appeared to resemble lactobacilli (10). Present in some smears were masses of either short varieties of this organism or a different organism of similar Gram staining property. Sometimes, especially when considerable numbers were present, a tendency existed for these organisms to stain in a granular manner. The second sub-group were Gram-negative and morphologically resembled coliform organisms or did not differ much from them.

Photomicrographs of the various organism types are reproduced in figure 1.

Variations in the establishment of microorganisms

Calf group 1 (hay plus rumen inoculation). Protozoa and bacteria of the two groups noted to be associated with hay ingestion were established in the rumens of eight calves, which had good quality alfalfa hay available to them from birth, before they reached the age of 3 weeks. The organisms still were present several weeks later in the seven calves which were continued on the experiment. "Grain-type" organisms were extremely scarce in samples from these calves (table 2).

TABLE 2

The influence of the ration and rumen inoculation on the establishment of certain microorganisms in calf rumens

Calf group	Ration	Age	No. calves examined	No. calves protozoa present	No. calves hay flora present		No. calves grain flora present	
					Group I	Group II	Group I	Group II
		(*wks.*)						
I	Hay plus inoculation	3	8	8	8	8	0	0
		6	7	7	7	7	0	0
II	Hay, uninoculated	3	8	0	8	3	0	0
		6	6	0	6	5	0	0
III	Hay and grain plus inoculation	3	7	6	2	1	2	0
		6	7	7	6	2	4	0
IV	Hay and grain, uninoculated	3	5	1	2	2	4	1
		6	5	1	2	2	5	3
V	Calf starter, uninoculated	3	4[a]	0	0	0	4	4
		6	2[a]	0	0	0	2	1

[a] 2 Calves received hay.

Calf group 2 (hay without rumen inoculation). Protozoa failed to make their appearance in samples from eight similarly-fed but uninoculated calves up to the time they reached the age of 3 weeks and up to 6 weeks in the case of the six of them that were continued on experiment. "Hay flora" of the paired coc-

cus type developed in all eight calves by the time they were 3 weeks old and continued to be present in samples from these calves throughout the experimental period. Samples from all but three of the eight calves contained organisms of the second hay sub-group when the calves were 3 weeks old. By 6 weeks of age, samples from five of the six calves contained some of at least one of the organisms of this sub-group. Organisms of the two grain types also were extremely scarce in samples from these calves (table 2). A fairly large Gram-positive rod, thicker and more tapered at the ends than the one seen in association with grain feeding, was observed in great numbers in samples from two of these calves by the time they were 3 weeks old and in five of the six at 6 weeks of age. These organisms never were observed in appreciable numbers in samples from any of the other calves.

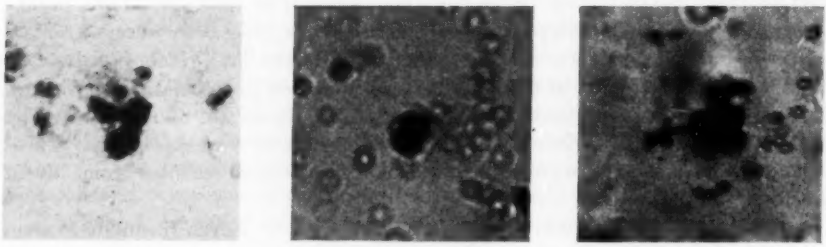
Calf group 3 (*hay, grain, plus rumen inoculation*). Seven inoculated calves were fed good quality alfalfa hay from birth and a simple 14 per cent protein grain mixture starting on the 14th day of age, both free choice. Protozoa became established in six, hay flora of the paired coccus organism sub-group in two, and hay flora of the second hay sub-group in one, by the time the calves were 3 weeks of age. By 6 weeks of age, samples from all seven had protozoa present, six contained hay flora of the first sub-group and two of the second. Gram-positive grain-type flora developed in two calves by 3 weeks and in four calves by 6 weeks of age (table 2).

Calf group 4 (*hay plus grain without rumen inoculation*). Only one of five uninoculated calves on a schedule of hay and grain similar to group III developed rumen protozoa by 4 weeks of age or even by 6 weeks of age. Flora of both hay groups were present in samples from two of the five calves by the time they were 3 weeks old but had not yet appeared in the other calves at 6 weeks of age. Bacteria of the first grain sub-group were visible in samples from four calves at 3 weeks of age and in all five calves at 6 weeks of age. Gram-negative bacteria of the second grain sub-group were observed in samples from one calf at 3 weeks and from three calves at 6 weeks of age (table 2).

Calf group 5 (*calf starter grain ration without inoculation*). Four uninoculated calves were fed a commercial calf starter grain ration in pellet form. Two of them received good quality alfalfa hay in addition. Both feeds were given free choice starting on the fourth day of age. The amount of milk fed one of the two calves receiving hay gradually was reduced as the calf increased its consumption of the grain. At 3 weeks of age, no protozoa or hay-type bacteria could be seen in samples from any of these four calves. However, great numbers of the grain-type organisms were present almost to the exclusion of all other bacteria. Only the two calves receiving hay were continued on experiment beyond 3 weeks of age. A similar condition was noted in them when they were 6 weeks of age, although the Gram-negative bacteria resembling coliform organisms appeared to be less prevalent (table 2).

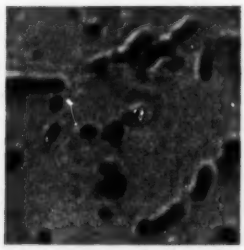
Samples from approximately 20 calves of similar age and on rations fairly similar to those used for the last two groups had been examined repeatedly the previous year. The results were very much the same.

Calf group 6 (shavings and straw bedding without inoculation). Neither protozoa nor hay-type flora were established in any one of seven uninoculated calves which were fed milk alone and bedded with shavings or straw up to the time they were 3 weeks of age. It also was questionable whether any of the



Hay Group I Organisms
(pairs and multiples of pairs)

Hay Group II Organisms
(thick rod, cigar-shaped rod, and group of small rods)



Grain Group I Organisms
(medium-sized rods)

FIG. 1. Photomicrographs of calf rumen microorganisms
(approximately ×1800)

grain-type flora were present in the samples. In fact, relatively few organisms of any kind were present even though all calves ate some of the bedding. Medium-sized, spindle-shaped bacteria which often contained spore-like bodies were present in appreciable numbers in samples from five out of six of these calves

which were bedded with shavings. These were the only ones in which this organism was ever observed.

Growth of the calves. An effort was made to have the two breeds about equally represented in each group with the exception of group VI, which was composed entirely of Jerseys. The average gains in weight made by the calves in all six groups were between 7 and 9 lb. per calf for the first 3 weeks. The calves in groups I, II, III and IV made an average gain of 15 to 16 lb. per calf during the second 3 weeks, while those in group V gained an average of 22 lb. Group VI was discontinued at the end of the first 3 weeks. These gains are lower than the standards given for calves of comparable breeds by Ragsdale (9). Although gain in weight was desired, it was not an objective in these experiments.

Health of the calves. The hair coats of calves on hay alone without rumen inoculation (Group II) appeared to be rougher than those on similar feed which received the inoculation (Group I). Any difference resulting from inoculation was less noticeable or non-existent between the groups of calves receiving rations containing grain. As reported elsewhere (5), calves in group I receiving hay and inoculation maintained on the average uniformly higher blood plasma levels of ascorbic acid during their first 6 weeks of age than any other group. The clinical manifestations of sickness were limited to digestive tract upsets. No trouble was experienced in this respect among the calves in groups I and II, although two calves in each group had rather soft feces on a single day each. The incidence of diarrhea among the calves in group III was 57 per cent, group IV 66 per cent, group V 75 per cent and for group VI 70 per cent. The duration of individual attacks ranged between 2 and 8 days.

Sources of the organisms other than from rumen materials. The organisms designated as Hay Group I and those associated with grain established themselves more readily by natural means in the young calves than did the protozoa and the organisms in Hay Group II. This indicates greater availability of sources of the former. Feces would be a logical source of organisms, augmenting the organisms spread through slobbers from cud-chewing mature animals. Baker (2) examined the feces from a bovine fed on hay and various concentrate rations for some of the characteristic organisms. He concluded that the majority of these organisms were destroyed on passage through the intestines. This seemed to be true based on our Gram stain examinations of fecal samples. However, limited numbers of organisms resembling those designated as Hay Group I and also the Gram-positive varieties of those associated with grain ingestion were present in seven fecal samples from rumen inoculated calves on hay and milk alone. They apparently also were present to a lesser extent in two of four samples from similar calves eating both hay and grain, and in six out of seven samples from cows on mixed rations. Although the varieties associated with grain ingestion were visible in three samples from calves on calf starter ration, no hay-type bacteria could be observed. A young calf was given, by stomach tube, repeated rumen inoculations with feces from a 5-month-old inoculated calf on a hay and skim-milk diet. None of the second-hay-group bacteria or rumen protozoa became established in its rumen even though the first-hay-group organisms did so. Thus,

it would appear that feces from older stock may provide a source from which some of the rumen microflora may be obtained by young calves.

DISCUSSION

It would appear from the present observations that rumen protozoa encounter difficulty in being transferred to young calves under conditions which frequently exist on dairy farms. However, their importance as regards the well-being of the host animals has not been fully established. It is not possible from our data to deduct that they were responsible for the higher blood plasma ascorbic acid levels reported elsewhere (5), or the better appearance of the inoculated calves which received hay alone. In fact, there is more indication that flora were involved because the calves in group I maintained higher blood plasma levels of ascorbic acid than group III, yet both had protozoa in their rumens. Furthermore, a much less satisfactory condition as regards hay-type flora existed in group III as compared to group I.

The type of feed ingested appeared to be the principal factor which influenced the establishment of the organisms designated as group I of those noted to associate with hay and both groups of organisms observed in association with grain ingestion. Evidently the same was partly true of organisms designated as group II of those observed to associate with hay, although the figures indicate a less satisfactory source of organisms for inoculation of the calves than existed for the former. The failure of inoculation to establish hay varieties of flora in calves provided with both hay and grain was unexpected and difficult to explain until later experiments were conducted. These showed that once the ratio of grain ingested exceeded the hay, the proportion of hay varieties of flora appeared to markedly decrease in the Gram stain preparations of rumen samples (8). Thus, it appears that the logical explanation is that some of the young calves tended to eat proportionately more grain than hay when both were offered free choice.

The practical observation that the early development of mature rumen function in young calves may be influenced for the better by inoculation, under some conditions, is probably of some significance. Whether the microscopic observations as outlined here are sufficiently sound and adequately described must await further experimental work under varied conditions. The varieties described as being associated with hay ingestion are sufficiently characteristic in morphology that their recognition probably is quite reliable. However, because of the lack of definite morphological individuality, recognition of organisms designated as associated with grain ingestion possibly is less accurate.

Quite probably the rumen flora may vary somewhat between herds. A slight indication of this has been obtained from examinations conducted on calves in a few other herds and from the reports of others. However, fairly similar conditions probably exist in the majority of herds as regards rumen microorganisms, and observations made on calves in various locations may be comparable.

The comparatively low milk consumption of the calves used in these experiments probably was responsible, especially during the first 3 weeks of age, for

the fact that weight gains were lower than accepted standards (9). The total consumption of milk during the 6-week-period was as low as 210 lb. each for most of the Jersey calves and only two Holsteins received more than 336 lb.

Apparently, rumen inoculation did not influence the ability of the calves to withstand the factors which existed in the herd that stimulated attacks of diarrhea. On the other hand, the type of ration fed, especially good alfalfa hay and milk, appeared to be of more value in preventing the occurrence of this malady. This naturally raises the question as to whether or not, under some conditions, the health of the digestive tracts of young calves may be jeopardized as the result of attempts to make rapid gains in weight at very early ages.

SUMMARY

The rumens of young calves being fed milk and various dry feed rations were inoculated with microorganisms from the rumens of mature stock by placing pieces of cuds from the latter in the posterior of the mouths of the calves. The inoculations were omitted from similarly fed calves used as controls.

The inoculations assisted in the establishment of protozoa in the rumens of calves eating either hay alone or both hay and grain. They assisted in the establishment of some, but not all, of the characteristic varieties of rumen microflora which were associated with hay ingestion in calves fed on alfalfa hay alone. The establishment of varieties of organisms which were associated with the ingestion of grain was not assisted by the inoculations. The establishment of the varieties of flora which were associated with hay ingestion was inhibited in some calves when grain was fed.

The inoculated calves on a diet of alfalfa hay and milk alone were considered to have a better appearance than the controls, but this difference was not apparent between the inoculated and uninoculated groups fed on both hay and grain. Data reported elsewhere (5) show that uniformly higher levels of ascorbic acid in the blood plasma were maintained during the first 6 weeks following birth in the inoculated calves fed alfalfa hay and milk alone than in the calves of any other group. Gains in weight by the calves were very similar in all groups during the first 3 weeks of age. During the second 3-week period, all groups made similar gains except group V, which received a commercial calf starter grain ration. The two groups of calves fed on alfalfa hay and milk alone were free of diarrhea, but the incidence in all other groups was in excess of 50 per cent.

Feces were examined in a search for sources of organisms which resembled natural inhabitants of rumens and some appeared to be present.

The authors wish to acknowledge the assistance of Mr. John Tate, Mr. R. L. Johnson, and Mr. C. E. Knoop in conducting this investigation.

REFERENCES

(1) BAKER, F. Normal Rumen Microflora and Microfauna of Cattle. Nature 149: 220. 1942.

(2) BAKER, F. Direct Microscopical Observations Upon the Rumen Population of the Ox. I. Qualitative Characteristics of the Rumen Population. Ann. Applied Biol., 30: 230–239. 1943.

(3) BAKER, F., AND HARRISS, S. T. The Role of Microflora of the Alimentary Tract of Herbivora with Special Reference to Ruminants. (2) Microbial Digestion in the Rumen (and Caecum), with Special Reference to the Decomposition of Structural Cellulose. Nutrition Abstracts & Revs., 17(1): 3–12. 1947.

(4) ELSDEN, S. R. Volatile Fatty Acids in the Rumen of the Sheep. Proc. Nutrition Soc., 3: 243–47. 1945.

(5) HIBBS, J. W., AND POUNDEN, W. D. The Influence of the Ration and Early Rumen Development on the Changes in Plasma Carotene, Vitamin A, and Ascorbic Acid in Young Dairy Calves. J. Dairy Sci., 31, 12: 1055–1060. 1948.

(6) PHILLIPSON, A. T. The Physiology of Digestion in the Ruminant. Vet. Record, 58: 81–87. 1946.

(7) POUNDEN, W. D., AND HIBBS, J. W. Some Possible Relationships Between Management, Fore-stomach Contents and Diarrhea in the Young Dairy Calf. J. Dairy Sci., 30: 582–583. 1947.

(8) POUNDEN, W. D., AND HIBBS, J. W. The Influence of the Ratio of Grain to Hay in the Ration of Dairy Calves on Certain Rumen Microorganisms. J. Dairy Sci., 31, 12: 1051–1054. 1948.

(9) RAGSDALE, A. C. Growth Standards for Dairy Cattle. Mo. Agr. Expt. Sta. Bull. 336. 1934.

(10) ZINSSER, H., AND BAYNE-JONES, S. A Textbook of Bacteriology. 7th Ed. p. 739. 1937.

THE INFLUENCE OF THE RATIO OF GRAIN TO HAY IN THE RATION OF DAIRY CALVES ON CERTAIN RUMEN MICROORGANISMS[1]

W. D. POUNDEN AND J. W. HIBBS
Ohio Agricultural Experiment Station, Wooster.

Variations were observed to occur in certain flora and fauna present in rumen samples from young calves which apparently depended upon the ratio of grain to hay that the calves ingested (1). This indication was pursued further to determine if the observed variations were consistent. Should this be the case, it was hoped that examinations of rumen contents and rumen microorganisms might prove to be more valuable in making differential diagnoses of some calf problems. For instance, information of what feeds have been ingested often is essential in order to determine with any degree of accuracy if a relationship exists between the feed and the unhealthy condition of the calves. Yet, it often is difficult to estimate what the calves actually have been eating when more than one feed has been offered free choice, including the bedding. This problem is complicated further when several calves are fed together in groups because of the individual variations that exist between calves in their choice of feeds.

It perhaps is of interest to add here that extreme variations in rumen microfauna and microflora were observed to be more frequent among young calves fed dry feeds free choice during their first few weeks of age than among similarly-fed older calves. This situation probably resulted from the fact that younger calves ate limited quantities of feed and often limited themselves to only one feed at a time. Because of the relatively small capacity of their rumens, the influence of eating a single feed on the microorganisms was much greater than in older calves in which the buffering effect of larger amounts of previously-eaten feeds existed.

METHODS

The 19 calves used were between 1 and 4.5 months of age. Rumen flora and fauna, which had been classified as quite characteristic, had been present in all the calves prior to the time this particular study was undertaken. Most of them had been inoculated by use of cuds from mature animals in the manner outlined previously (1). It was difficult to determine accurately the relative quantities of hay and grain ingested by calves younger than these and, consequently, data from such calves were omitted.

The quantities of hay and grain consumed during the 4 days prior to the examinations were used in arriving at the relative ratios of the two feeds eaten by the calves. However, they actually were consuming approximately the same proportions for some days longer than this. This period was chosen on the basis of experience with the establishment of characteristic flora and fauna in the rumens of young calves.

Received for publication August 3, 1948.

[1] Journal article No. 30–48, Ohio Agricultural Experiment Station. Published with the approval of the Associate Director of the Ohio Agricultural Experiment Station.

Some calves received different ratios of hay to grain at different times either by design or their own choice and, consequently, data from them were included in more than one category. The hay was fairly good quality alfalfa hay and the grain was a simple 14 per cent protein mixture containing 4 parts of corn, 3 of oats, 1 of bran and 1 of soybean oil meal.

Rumen samples were obtained by use of stomach tubes and examined microscopically in the fresh state and by use of Gram stains as outlined previously (1). The preparations were examined for the same organisms as those discussed in the previous paper (1). Two main groups of bacteria were noted, one associated with hay ingestion and the other with grain, and two sub-groups were recognized in each group.

RESULTS

The results of 35 examinations are summarized in table 1. Column 3 in the

TABLE 1

The influence of the ratio of grain to hay on some calf rumen microorganisms

Ratio Grain : Hay	No. rumen samples	No. samples protozoa present	No. samples Hay flora present		No. samples Grain flora present	
			Group I	Group II	Group I	Group II
0 : 1	19	19	19	19		
1 : 3	6	6[b]	6	6	1	1
					4[a]	
2 : 3	4	3[b]	4	2	4	2
		1		2[a]		
1 : 1	6	6[b]	6	3	3	5
				1[a]		
3 : 2	3	2[b]	3	2	3	2
		1[a]				
3 : 1	2	2[a]			1[b]	1[b]
					1	1
1 : 0	5	1[a]			4[b]	3[b]
						1

[a] = few; [b] = masses; unmarked = moderate or appreciable numbers.

table shows that protozoa were present in all samples except four of the five from animals on grain without hay. Moderate numbers were observed to be present when the dry feed ration consisted of hay alone. With the addition of some grain to the ration, the numbers of protozoa in the samples increased greatly. This is in agreement with the findings of others as summarized by Phillipson (2). A marked reduction in numbers followed, once the ratio exceeded 3 parts of grain to 2 parts of hay. Limited numbers only were present in samples from calves eating three or more times as much grain as hay. The one calf receiving grain without hay, but still having protozoa present in the rumen, was one of the oldest calves used. It had been fed grain with straw for bedding for 10 days at the time of the examination.

Organisms which were classified as belonging to the hay flora groups were visible in Gram stain preparations of all 19 samples from calves on rations of hay alone. The prevalence of these organisms in the smears appeared to in-

crease with the addition of some grain to this ration. However, as the proportion of grain ingested approached quantities equal to the hay, a reduction was rather apparent. Organisms of the second hay group were reduced more noticeably than those of the first hay group in samples from animals eating as much or more grain than hay. As shown in columns 4 and 5, both groups of the organisms associated with hay were missing from the samples once the ratio reached 3 parts of grain to 1 of hay. Thus, the organisms associated with hay consumption disappeared from the rumen samples at lower ratios of grain to hay than did the protozoa. The apparent increases in the flora associated with hay ingestion on the addition of some grain to rations of hay alone may have resulted from the eating of more balanced rations by the calves. Such is suggested by the observations of Van der Wath, as cited by Phillipson (2), that bacterial numbers were influenced by the diet, with balanced rations being the most satisfactory.

Only limited numbers of the bacteria which were observed to associate with grain rations were visible in the samples until a proportion of 3 parts of grain to 2 of hay was being consumed (columns 6 and 7). These organisms increased in relative prevalence in comparison with other flora as the proportion of grain increased. On rations of grain alone, some samples appeared to contain practically no other organisms.

Very small Gram-negative organisms were noticeably prevalent in samples from calves on rations containing hay alone or high proportions of hay. Small Gram-positive short rods or cocci were observed in increasing proportions on the addition of grain to rations of hay.

Although data collected on this group of calves are very limited, they indicate that by observing certain flora and fauna present in rumen samples from calves, it may be possible to estimate the relative ratio of grain to hay that they are ingesting.

SUMMARY

A total of 35 rumen samples from 19 calves between the ages of 1 and 4.5 months were examined microscopically. The calves received rations of alfalfa hay or grain alone, or various proportions of these. Most of them had received rumen inoculations and the remainder had been exposed to usual rumen microorganisms in a natural manner.

Moderate numbers of protozoa and flora of varieties observed to associate with hay ingestion accompanied the ingestion of hay without grain.

Masses of protozoa along with fairly numerous flora of the 2 hay groups were associated with the consumption of hay and moderate quantities of grain.

Similar concentrations of protozoa, accompanied by rather limited numbers of organisms of the hay groups and fairly numerous bacteria of the varieties observed to associate with grain consumption, accompanied the ingestion of approximately equal quantities of hay and grain.

Limited numbers of protozoa accompanied by great numbers of bacteria of the grain groups, but no organisms of the hay groups, were present when the ration consisted of almost all grain.

Protozoa and organisms of the varieties associated with hay ingestion generally were absent entirely in samples from calves on strictly grain rations.

The authors wish to acknowledge the assistance of Mr. John Tate, Mr. R. L. Johnson and Mr. C. E. Knoop in conducting this investigation.

REFERENCES

1. POUNDEN, W. D. AND HIBBS, J. W. The Influence of the Ration and Rumen Inoculation on the Establishment of Certain Microorganisms in the Rumens of Young Calves. J. Dairy Sci., 31, 12: 1041–1050. 1948.
2. PHILLIPSON, A. T. The Physiology of Digestion in the Ruminant. Vet. Record, 58: 81–87. 1946.

THE INFLUENCE OF THE RATION AND EARLY RUMEN DEVELOPMENT ON THE CHANGES IN THE PLASMA CAROTENOIDS, VITAMIN A AND ASCORBIC ACID OF YOUNG DAIRY CALVES[1]

J. W. HIBBS AND W. D. POUNDEN

Ohio Agricultural Experiment Station, Wooster

The period between birth and the time a calf has developed into a normally-functioning ruminant is recognized as critical from the standpoint of nutritional well-being and health. As pointed out by Pounden and Hibbs (8), this period may extend for many weeks in some cases, when judged by the presence or absence of characteristic rumen microorganisms.

Several reports have appeared in the literature showing the usual changes in the blood plasma carotenoids and vitamin A of calves from birth to several weeks of age (1, 2, 3, 6, 11, 12, 14, 15). The changes in plasma ascorbic acid have been reported by Phillips *et al.* (7), Hibbs and Krauss (2), Sutton and Kaeser (12), and Teeri *et al.* (14).

Wise *et al.* (15) have reported results showing that after the blood carotenoids reach a peak on about the third day, as the result of colostrum feeding, there is a rapid decline for from 4 to 5 weeks and then a gradual rise to the post-colostrum feeding level or slightly above at 8 to 10 weeks of age. Vitamin A follows a somewhat similar trend. Teeri *et al.* (14) report that, on the average, blood carotenoid values level off between 15 and 23 weeks of age at about 44 γ per 100 ml. in Holstein calves and at about 65 γ per 100 ml. in Jersey and Guernsey calves. Considerable individual variation is indicated by the high and low values obtained in calves apparently fed and managed alike.

It is striking that until most calves are several months old their blood carotenoid levels do not even approach the levels found in mature animals fed on dry feeds. This may be the result of the ability of the mature animal to consume relatively large quantities of roughage. It is not illogical, however, in the light of our previous observations regarding the variations in the rate of establishment of characteristic rumen microorganisms in calves (8), to assume that the differences in the blood carotenoids and vitamin A levels between calves and adult animals might be due, at least in part, to their relative ability to digest roughage in the rumen. Furthermore, many of the individual variations found among calves may be due, in part, to the differences in the age at which normal rumen function begins.

Investigations were undertaken, therefore, to study the influence of the ration and rumen inoculations on the establishment of rumen function in young calves, the results of which are reported elsewhere (9, 10). Concurrently, a study was made on the influence of the ration and early rumen development on the changes

Received for publication August 3, 1948

[1] Journal Article no. 29-48, Ohio Agricultural Experiment Station. Published with the approval of the Associate Director of the Ohio Agricultural Experiment Station.

occurring in the plasma carotenoids, vitamin A and ascorbic acid of dairy calves during their early postnatal development.

EXPERIMENTAL

Plasma vitamin A and carotenoids were determined by the method described by Kimble (4). The method of Mindlin and Butler (5) was used to determine plasma ascorbic acid.

After a colostrum feeding period, usually 3 days, all calves were fed whole milk for the entire experimental period of 6 weeks at the rate of 0.9 lb. per 10 lb. of body weight at birth. This relatively low level of milk feeding was adopted in order to encourage the calves to consume more of the dry feeds offered.

Beginning on the fourth day of age, calves born in the herd from January until April, 1948 were assigned to one of six groups and fed whole milk and various dry feeds with and without rumen inoculations as follows: Group I, alfalfa hay plus rumen inoculations; Group II, alfalfa hay alone; Group III, alfalfa hay plus grain (14 per cent protein herd ration) plus rumen inoculations; Group IV, alfalfa hay plus grain (14 per cent protein herd ration); Group V, alfalfa hay plus standard calf starter pellets; Group VI, whole milk only (this group was continued on experiment for only 3 weeks).

The rumen inoculations in groups I and III were accomplished by direct transfer of small pieces of cud material to the mouths of the calves from cows in the herd. This was done in order to make certain that these calves had access to the microorganisms normally present in the rumens of the adult animals.

All calves were bled as nearly as possible on the fourth and seventh days of age and weekly thereafter until the forty-second day of age and the plasma carotenoids, vitamin A and ascorbic acid were determined.

The results of the blood analyses are shown in table 1. No beneficial effect of rumen inoculations on the blood plasma carotenoids was observed. Average figures for the calves in groups III, IV and V, which were fed grain, show that when grain was included in the ration, plasma carotenoids did not increase during the first 6 weeks to the extent observed in groups I and II, which were fed alfalfa hay as the only dry feed. The calves in groups I and II made an average steady increase in plasma carotenoids from 4 days until 42 days of age, reaching extremely high levels as compared to any of the other groups.

Plasma vitamin A was found to decrease markedly from the fourth until the forty-second day of age in all groups except group V, which received a calf starter containing 5,000 U.S.P. units of supplemental vitamin A per lb. No marked beneficial effect from rumen inoculations was noted on the plasma vitamin A level although the values for vitamin A appear to be somewhat higher in group III as compared to group IV.

The level of plasma ascorbic acid was found to decline between the seventh and fourteenth days of age in all groups except group I, which was fed alfalfa hay plus rumen inoculations. This group maintained the most uniformly high level of plasma ascorbic acid during the first 4 weeks of any of the groups.

TABLE 1

The influence of the ration on the changes in the plasma carotenoids, vitamin A and ascorbic acid of the blood of young calves

Group[a]	No. of calves	Plasma carotenoids Ages of animals						
		4 days	7 days	14 days	21 days	28 days	35 days	42 days
				Plasma carotenoids (γ/100 ml.)				
I	6	32.3 ± 6.8[b]	34.9 ± 5.5	42.5 ± 4.4	58.2 ± 16.3	76.9 ± 14.2	93.2 ± 20.0	99.2 ± 23.3
II	6	35.9 ± 5.7	38.2 ± 5.8	49.9 ± 14.0	53.6 ± 19.4	67.9 ± 23.9	92.6 ± 20.0	96.6 ± 22.0
III	7	20.6 ± 2.9	20.7 ± 3.1	34.0 ± 7.7	37.0 ± 12.7	32.7 ± 9.1	36.2 ± 10.7	49.7 ± 3.3
IV	5	21.5 ± 3.9	32.7 ± 9.8	36.2 ± 7.5	35.4 ± 13.7	35.2 ± 10.3	44.4 ± 12.3	56.8 ± 15.4
V	4	38.4 ± 20.0	32.7 ± 8.4	35.1 ± 8.9	31.4 ± 10.3	33.0 ± 0.0	35.5 ± 10.7	28.3 ± 2.6
VI	6	19.4 ± 3.5	22.4 ± 4.5	27.5 ± 4.6	20.0 ± 2.6			
				Plasma Vitamin A (γ/100 ml.)				
I	6	20.3 ± 3.3	16.4 ± 3.1	14.8 ± 1.5	12.1 ± 0.9	10.8 ± 1.2	9.2 ± 1.8	8.1 ± 1.0
II	6	16.1 ± 2.8	13.7 ± 2.3	11.7 ± 1.5	9.6 ± 2.2	6.8 ± 1.6	7.5 ± 1.1	7.7 ± 1.1
III	7	13.1 ± 1.8	12.2 ± 2.5	11.6 ± 1.3	10.5 ± 1.6	7.9 ± 1.1	8.9 ± 1.5	9.0 ± 1.2
IV	5	13.5 ± 1.4	9.9 ± 1.2	8.6 ± 1.4	8.8 ± 1.0	6.5 ± 0.9	7.0 ± 0.7	6.3 ± 0.3
V	4	15.1 ± 5.3	13.4 ± 4.6	12.8 ± 3.1	11.7 ± 1.8	15.0 ± 0.0	16.0 ± 2.5	14.7 ± 1.8
VI	6	9.2 ± 1.7	7.9 ± 1.3	9.4 ± 0.9	6.3 ± 1.4			
				Plasma ascorbic acid (mg./100 ml.)				
I	5		0.47 ± 0.06	0.46 ± 0.03	0.42 ± 0.04	0.47 ± 0.03	0.43 ± 0.09	0.36 ± 0.05
II	5		0.47 ± 0.06	0.27 ± 0.05	0.25 ± 0.01	0.29 ± 0.05	0.46 ± 0.04	0.42 ± 0.03
III	7		0.49 ± 0.02	0.26 ± 0.03	0.38 ± 0.07	0.33 ± 0.04	0.38 ± 0.06	0.41 ± 0.05
IV	5	0.44 ± 0.03	0.36 ± 0.04	0.33 ± 0.09	0.32 ± 0.02	0.30 ± 0.05	0.40 ± 0.08	0.50 ± 0.07
V	3		0.41 ± 0.05	0.30 ± 0.04	0.40 ± 0.00	0.39 ± 0.00	0.30 ± 0.00	0.44 ± 0.00
VI	6	0.53 ± 0.01	0.59 ± 0.03	0.33 ± 0.08	0.35 ± 0.04			

[a] Group I. Whole milk plus alfalfa hay plus rumen inoculations.
Group II. Whole milk plus alfalfa hay.
Group III. Whole milk plus alfalfa hay plus grain plus rumen inoculations.
Group IV. Whole milk plus alfalfa hay plus grain.
Group V. Whole milk plus commercial calf starter.
Group VI. Whole milk only.

[b] Standard error.

By the fifth week there was very little difference among all the groups. Group II, which received alfalfa hay alone without the rumen inoculations, declined in plasma ascorbic acid to the lowest level of any of the groups during the first 4 weeks. Groups III, IV and V, in which grain was included in the ration, declined sharply but recovered to a level intermediate between groups I and II by the twenty-first day of age.

In view of these results, it was decided to investigate the possible effects of the addition of grain to the ration of older calves which had been fed hay as the only dry feed. Four calves from groups I and II were continued on whole milk plus alfalfa hay to an average of 64 days of age.

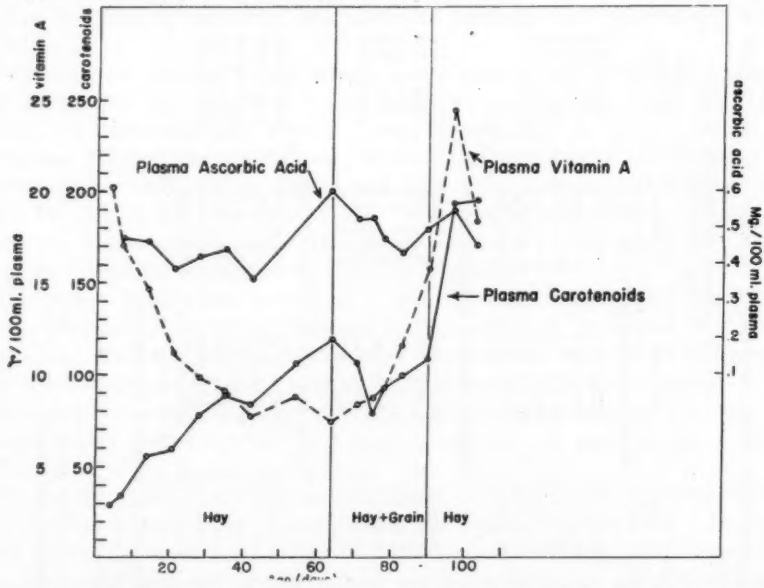


FIG. 1. The influence of adding grain to the ration of 64-day-old calves fed only whole milk and alfalfa hay until that time.

As shown in figure 1, the average plasma carotenoids had increased consistently from 29 γ per 100 ml. at 4 days of age to 118 γ per 100 ml. at 64 days of age. Plasma vitamin A had declined from 20.2 to 7.4 γ per 100 ml. during the same period, and plasma ascorbic acid values had increased from 0.47 to 0.60 mg. per 100 ml.

At this point, a 14 per cent protein grain mixture was included *ad libitum* in the ration. The week prior to the change in ration the calves were eating an average of 2.4 lb. of hay per day. Hay consumption decreased during the grain feeding period. After 4 weeks of grain feeding, the calves were eating 1.7 lb. of hay and 2.6 lb. of grain per day. Grain then was removed from the ration, and during the following week the calves consumed an average of 2.6 lb. of hay per day.

Figure 1 indicates the changes that occurred in the levels of blood plasma carotenoids, vitamin A and ascorbic acid as the result of adding grain to the ration. The plasma carotenoid level was shown to decrease, the plasma vitamin A increased and the plasma ascorbic acid decreased during this period. When grain was removed from the ration, the carotenoids rapidly increased from 108 to 193 γ per 100 ml. within a week, and the plasma vitamin A continued to rise to a peak of 24.3 γ per 100 ml. No marked changes occurred in the plasma ascorbic acid level after the grain was removed from the ration.

DISCUSSION

So far as the blood picture is concerned, the only marked beneficial effect of rumen inoculations appeared to be the higher plasma ascorbic acid level maintained in group I as compared to group II, where alfalfa hay was the only dry feed fed. The mode of action through which this effect was elicited is not readily explainable.

The suppressing action of grain feeding on the blood plasma carotenoids is strikingly demonstrated by the differences in the plasma carotenoid levels between groups I and II, which were fed hay alone, and groups III, IV and V, which received grain in addition to the hay. Accurate records of hay consumption were difficult to obtain during the first few weeks. Therefore, data are not available to demonstrate conclusively whether increased hay consumption or increased digestibility of the hay played the leading role in causing the relatively higher plasma carotenoid level of groups I and II as compared to groups III, IV and V. Indications from the data obtained were that the calves fed grain consumed less hay than those fed hay alone. It would seem that decreased digestibility of the hay possibly was a factor contributing to the low carotenoid levels observed in the grain-fed groups based on the conditions observed with respect to the microorganisms in the rumen when high proportions of grain to hay were fed (10). This would be likely especially when grain consumption reached a level equal to or higher than the hay consumption, as was the case in many instances.

It was noted that the plasma vitamin A level decreased when the plasma carotenoids were increased in groups I and II. The opposite effect on plasma vitamin A was observed when plasma carotenoids declined following the addition of grain to the ration of 64-day-old calves (fig. 1). This suggests that the plasma vitamin A level of the blood is not always a reliable indicator of the state of vitamin A metabolism in the young calf.

Sutton and Soldner (13) have presented data showing that in adult cattle the seasonal changes in blood plasma vitamin A do not closely follow blood plasma carotene changes but tend to lag behind. Plasma vitamin A often was observed to increase when plasma carotene was on the decline.

There are several factors which may be responsible for these apparent discrepancies in the behavior of plasma vitamin A in relation to the plasma carotenoids. Possibly, one of these complicating factors is the liver storage of vitamin A. The degree of saturation of the liver and whether the vitamin A

stores are being increased or depleted may influence the plasma vitamin A level, independent of the effect of the intake of carotene from the roughage. It also is possible that factors affecting the conversion of carotene to vitamin A complicate the blood picture. The answers to these questions must await further work involving the relationship between blood plasma vitamin A and liver storage, the sources of vitamin A and carotene and the physiology of the conversion of carotene to vitamin A in the calf.

SUMMARY AND CONCLUSIONS

Preliminary investigations indicated that the development of the rumen in young calves is influenced by the type of ration fed. Experiments were conducted, therefore, to determine the effect of different rations and early rumen development on the levels of vitamin A, carotenoids and ascorbic acid in the blood of young dairy calves.

Rumen inoculations, accomplished by direct transfer of cud material from cows in the herd to the calves, were supplied to about one-half the calves in order to make certain that they had access to the microorganisms present in the rumens of adult animals.

Rumen inoculations were effective in preventing the usual drop in blood plasma ascorbic acid between the seventh and fourteenth days of age when only alfalfa hay and milk were fed but were ineffective when grain was included in the ration. A ration of whole milk and alfalfa hay alone resulted in carotenoid levels considerably higher after 14 days of age than was observed when grain was included in the ration. Rumen inoculations had no marked effect on the blood carotenoid levels. Neither the inoculations nor the type of ration fed markedly influenced the blood plasma vitamin A.

When grain was introduced into the ration of 64-day-old calves, which had been fed only alfalfa hay and milk until that time, a marked reduction in hay consumption and blood carotenoids resulted. Plasma vitamin A increased and ascorbic acid declined during the same period.

These results, when correlated with the effect of different rations on the development of various rumen microorganisms in these calves, indicate that palatable, high quality hay stimulates the early development of rumen function in the young calf and appears to have a favorable physiological effect in meeting the vitamin needs of these animals.

The authors wish to acknowledge the assistance of Mr. John Tate, Miss Barbara Carson and Mr. C. E. Knoop in conducting this investigation.

REFERENCES

(1) ARRINGTON, L. R., AND REAVES, P. M. Studies of the Growth and Blood Composition of Dairy Calves Fed Remade Skim Milk After Three Days of Age. J. Dairy Sci., 31 (1): 1–10. 1948.

(2) HIBBS, J. W., AND KRAUSS, W. E. The Effect of Supplementary Vitamins on Blood Composition, Liver Storage and Incidence of Scours in Calves. J. Dairy Sci., 30 (2): 115–120. 1947.

(3) KEENER, H. A., BECHDEL, S. I., GUERRANT, N. B., AND THORP, W. S. T. Carotene in Calf Nutrition. J. Dairy Sci., 25 (7): 571–584. 1942.

(4) KIMBLE, M. S. The Photoelectric Determination of the Vitamin A and Carotene in Human Plasma. J. Lab. Clin. Med., 24: 1055–1065. 1939.

(5) MINDLIN, R. L., AND BUTLER, A. M. The Determination of Ascorbic Acid in Plasma: A Macromethod and a Micromethod. J. Biol. Chem., 122: 673–686. 1938.

(6) MOORE, L. A., AND BERRY, M. H. Vitamin A and Carotene Content of the Blood Plasma of Dairy Calves from Birth Up to Four Months of Age. J. Dairy Sci., 28 (11): 821–826. 1945.

(7) PHILLIPS, P. H., LUNDQUIST, N. S., AND BOYER, P. D. The Effect of Vitamin A and Certain Members of the B-Complex upon Calf Scours. J. Dairy Sci., 24 (11): 977–982. 1941.

(8) POUNDEN, W. D., AND HIBBS, J. W. Some Possible Relationships Between Management, Fore-stomach Contents and Diarrhea in the Young Dairy Calf. J. Dairy Sci., 30 (8): 582–583. 1947.

(9) POUNDEN, W. D., AND HIBBS, J. W. The Influence of the Ration and Rumen Inoculations on the Establishment of Certain Microorganisms in the Rumens of Young Calves. J. Dairy Sci., 31, 12: 1041–1050. 1948.

(10) POUNDEN, W. D., AND HIBBS, J. W. The Influence of the Ratio of Grain to Hay in the Ration of Dairy Calves on Certain Rumen Microorganisms. J. Dairy Sci., 31, 12: 1051–1054. 1948.

(11) SPIELMAN, A. A., LOOSLI, J. K., THOMAS, J. W., NORTON, C. L., AND TURK, K. L. Carotene Utilization in the Newborn Calf. J. Dairy Sci., 29 (6): 381–391. 1946.

(12) SUTTON, T. S., AND KAESER, H. E. Some Physiological Effects of Extending the Colostrum Feeding Period of Dairy Calves. J. Dairy Sci., 29 (1): 13–26. 1946.

(13) SUTTON, T. S., AND SOLDNER, P. A. Seasonal Variations in the Blood Plasma Carotene and Vitamin A of Adult Dairy Cattle. J. Dairy Sci., 28 (11): 859–867. 1945.

(14) TEERI, A. E., KEENER, H. A., AND MORROW, K. S. Studies on the Chemical Composition of Calf Blood. J. Dairy Sci., 29 (10): 663–667. 1946.

(15) WISE, G. H., CALDWELL, M. J., PARRISH, D. B., ATKESON, F. W., AND HUGHES, J. S. Relation of Typical Postnatal Changes in the Diet of the Dairy Calf to the Concentration of Carotenoids and Vitamin A in the Blood Serum. J. Animal Sci., 7 (1): 70–77. 1948.

THE EFFECT OF SUPPLEMENTAL VITAMIN A UPON GROWTH, BLOOD PLASMA CAROTENE, VITAMIN A, INORGANIC CALCIUM, AND PHOSPHORUS OF HOLSTEIN HEIFERS[1, 2]

R. H. ROSS[3] AND C. B. KNODT

Department of Dairy Husbandry, Pennsylvania Agricultural Experiment Station, State College[4]

The nutritional value of vitamin A for dairy cattle has been generally accepted and numerous investigators have studied the minimum vitamin A and carotene requirements of calves and heifers for growth. Boyer *et al.* reported that 75 γ of carotene per kg. body weight was adequate for yearling Holstein heifers. Jones and Haag (5) found that heifers did not require supplemental vitamin A for growth and reproduction if they were pastured during the summer. Keyes *et al.* (6) obtained more gain in body weight by supplementing a standard calf starter with vitamin A. With this in mind, a study was undertaken to determine the value of supplementing one of the commonly used heifer rations with vitamin A. The effect of supplemental vitamin A upon blood plasma carotene, vitamin A, inorganic calcium and phosphorus concentrations and growth was studied.

EXPERIMENTAL PROCEDURE

A preliminary experiment was conducted with 22 Holstein heifers from February 1 to May 24, 1946. These animals were divided into two similar groups based upon age and body weight. Both groups were fed and managed identically except that the vitamin A group received supplemental vitamin A. The vitamin A supplement used in these trials was prepared from a fish liver oil source in linseed oil meal and soybean oil meal in the amount of 250,000 USP units per lb. based on manufacturer's analysis. The basal and experimental rations were prepared with similar composition except for the supplemental vitamin A. The animals were fed mixed hay *ad libitum* and 10 lb. of grass silage and 8 lb. of a grain mixture containing 14 per cent crude protein per day. After April 1 the amount of grain was increased to 10 lb. per day.

Growth was determined by measuring body weight and height at withers of the animals. They were weighed and measured at the beginning and end of the experiment with one intermediate weight taken in April.

Blood plasma carotene and vitamin A were determined at monthly intervals using the methods of Moore (8) and Kimble (7), respectively. Blood plasma inorganic calcium and phosphorus were determined at monthly intervals using

Received for publication March 12, 1948.

[1] Authorized for publication on *October 2, 1947* as Paper no. *1396* in the Journal Series of The Pennsylvania Agricultural Experiment Station.

[2] The data contained in this paper are from a thesis submitted by the senior author to the Graduate School of The Pennsylvania State College in partial fulfillment of the requirements for the Degree of Doctor of Philosophy, 1947.

[3] Now affiliated with the Department of Dairy Husbandry, University of Idaho, Moscow.

[4] These studies were financed in part by a grant from The Borden Company, New York.

the Clark-Collip modifications (3) of the Kramer-Tisdall method for calcium and the method of Gomori (4) for phosphorus, respectively.

The main experiment was conducted from January 1 to May 6, 1947, using 28 Holstein heifers. These heifers were divided into two similar groups based upon age, body weight, blood plasma carotene and vitamin A, and blood plasma inorganic calcium and phosphorus concentrations. Both groups were fed and managed identically except that the vitamin A group received supplemental vitamin A in the form used in the preliminary trials. The heifers were fed a weighed amount of mixed hay and grass silage at each feeding. They also received 10 lb. of grain per day.

Growth of the heifers was measured by determining the body weight and height at withers at the beginning and end of the experiment with one intermediate weight in March. Chemical analyses were the same as in the preliminary experiment, except that in the determination of blood plasma carotene and vitamin A the carotene was removed (1) previous to determining vitamin A when over 200 γ of carotene per 100 ml. were present. All data obtained in these trials were treated statistically where applicable (10).

RESULTS

In the preliminary experiment, the 11 heifers in the vitamin A group received an average daily intake of 40,382 USP units of supplemental vitamin A. This resulted in no significant differences in gain of body weight or height at withers between the two groups of 11 heifers each. The control group gained 130 lb. and 4.9 cm. and the vitamin A group gained 135 lb. and 4.9 cm.

In the main experiment the basal ration contained an average of 114,000 USP units of vitamin A per daily allowance per heifer. This was supplemented with 129,400 USP units of vitamin A per day for the 14 heifers in the vitamin A group. An analysis of variance of the gains in weight and height at withers as presented in table 1 showed a significant increase in gain in weight but no significant difference in gain in height at withers resulting from feeding supplemental vitamin A. The vitamin A group of 14 heifers gained an average of 235.9 lb. and 9.4 cm. while the control group gained 187.6 lb. and 8.4 cm., or a difference of 48.3 lb. and 1.0 cm. The heifers in the vitamin A group exhibited better condition, being smoother throughout and showing more flesh. The hair was glossier and smoother, and the hides seemed to be more pliable than those of the control group.

Feeding supplemental vitamin A at either level increased the blood plasma vitamin A concentrations and decreased the blood plasma carotene concentrations of the heifers. The mean blood plasma vitamin A concentrations of the heifers used in the preliminary trial were 18.14 γ per 100 ml. for the control group and 21 γ per 100 ml. for the vitamin A group during this trial. Similarly, during the main trial the mean blood plasma vitamin A concentrations were 15.82 and 21.71 γ per 100 ml. for the control and vitamin A-fed groups, respectively. These differences were highly significant statistically. The data from the main trial are presented in table 2. During the course of this trial, the blood plasma vitamin

A concentrations of the control group increased an average of 1 γ of vitamin A per 100 ml., whereas that of the vitamin A group increased 9 γ per 100 ml. The mean for each group was 14 γ of vitamin A per 100 ml. at the beginning of the trial.

The feeding of supplemental vitamin A resulted in a depression of the blood plasma carotene concentrations. In the preliminary trial, the blood plasma carotene concentration of the vitamin A-fed group decreased from 183

TABLE 1

Growth of heifers during main experiment

Heifer no.	Body weight			Height at withers		
	Initial	Final	Gain	Initial	Final	Gain
	(*lb.*)	(*lb.*)	(*lb.*)	(*cm.*)	(*cm.*)	(*cm.*)
			Control group			
729	700	875	175	120	124	4
732	668	800	132	113	120	7
734	749	967	218	120	128	8
737	565	716	151	113	120	7
738	600	800	200	115	121	6
740	513	732	219	112	120	8
742	637	871	234	110	120	10
744	526	675	149	106	117	11
747	513	700	187	106	115	9
749	456	579	123	106	115	9
752	374	622	248	100	110	10
755	404	610	206	101	106	5
756	334	513	179	96	107	11
757	344	550	206	94	107	13
$\overline{X}$	527	715	188	108	116	8
			Group fed vitamin A			
731	766	908	142	121	126	5
733	716	1027	311	117	123	6
735	732	1069	337	116	124	8
736	668	930	262	110	118	8
739	668	970	302	114	120	6
741	555	750	195	108	116	8
743	637	890	253	109	119	10
745	501	700	199	109	121	12
746	489	725	236	105	117	12
748	539	755	216	104	118	14
751	404	615	211	101	111	10
753	384	560	176	99	110	11
754	344	593	249	100	109	9
759	275	489	214	93	106	13
$\overline{X}$	548	784	236	108	117	9

to 96 γ per 100 ml., whereas the control group decreased from 220 to 153 γ per 100 ml. During the main trial, the blood plasma carotene concentrations decreased from 278 to 156 and from 271 to 85 γ per 100 ml. of blood plasma for the control and vitamin A-fed groups, respectively. Analyses of variance proved this difference to be highly significant statistically.

Blood plasma carotene and vitamin A determinations were continued during June, July and August, while the cattle were on pasture after the preliminary experiment, to determine if there was a carry-over effect from feeding supple-

TABLE 2

The effect of supplemental vitamin A upon blood carotene, vitamin A, calcium and phosphorus

Heifer no.	Carotene			Vitamin A			Calcium			Phosphorus		
	Nov. 26	March 11	May 6	Nov. 26	March 11	May 6	Nov. 26	March 11	May 6	Nov. 26	March 11	May 6
	(γ/100 ml.)			(γ/100 ml.)			(mg./100 ml.)			(mg./100 ml.)		
						Control group						
729	393	175	153	17	19	15	8.80	8.68	8.28	8.10	8.63	7.15
732	650	184	134	13	16	13	9.80	9.18	9.31	9.18	7.94	7.56
734	260	142	140	21	24	21	8.93	8.18	8.68	10.11	8.69	9.18
737	501	232	178	11	20	13	10.17	8.25	8.68	10.39	8.75	8.32
738	375	119	108	18	16	17	9.11	9.05	9.08	9.06	9.12	8.21
740	404	190	170	12	18	27	9.36	9.67	9.03	10.11	9.25	7.35
742	210	246	199	13	18	13	10.11	9.05	9.72	8.81	8.81	6.52
744	175	184	178	12	16	17	9.73	9.36	9.40	9.44	9.30	8.57
747	307	236	167	17	15	18	9.67	8.74	8.91	8.93	10.54	7.93
749	156	187	151	4	13	9	9.67	9.30	9.72	8.57	10.54	7.72
752	94	131	126	16	11	13	9.49	9.55	9.72	8.69	9.63	8.45
755	94	134	151	19	15	14	9.55	9.11	9.66	9.97	10.25	8.93
756	148	151	164	15	14	15	9.24	9.55	8.80	10.04	11.21	9.44
757	123	156	159	14	11	12	9.80	9.67	9.14	9.13	9.57	8.45
$\bar{X}$	278	176	156	14	16	15	9.53	9.10	9.15	9.32	9.45	8.13
						Group fed vitamin A						
731	634	96	108	17	18	19	8.93	9.05	9.14	9.70	6.76	6.72
733	522	116	112	23	19	18	8.56	8.87	8.51	9.18	7.88	6.81
735	398	100	105	20	22	24	9.73	9.18	9.14	7.46	8.75	6.47
736	466	156	134	17	28	34	9.61	9.61	9.26	7.05	7.88	8.10
739	561	114	85	20	26	40	9.42	9.55	9.08	8.81	7.67	6.95
741	149	112	67	1	15	12	9.61	9.11	9.89	7.25	9.30	7.20
743	183	137	105	13	26	22	9.49	9.30	9.89	8.10	6.86	6.76
745	123	103	76	7	18	19	10.11	9.92	9.77	10.39	9.44	7.72
746	224	98	74	11	18	20	10.11	8.87	8.97	6.81	9.44	6.66
748	123	69	52	7	21	24	9.73	9.49	9.08	9.70	9.57	7.15
751	96	78	63	17	17	23	9.80	8.93	10.23	9.97	9.37	7.56
753	96	33	48	13	13	20	9.42	9.42	9.43	8.57	7.88	7.35
754	105	80	63	16	20	23	9.80	10.04	9.31	10.39	9.18	7.15
759	110	91	94	15	19	30	8.99	8.68	9.49	8.95	9.97	8.93
$\bar{X}$	271	99	85	14	20	23	9.52	9.29	9.37	8.74	8.57	7.25

mental vitamin A. It was found that the heifers receiving supplemental vitamin A had lower blood plasma carotene and vitamin A concentrations while on pasture than the heifers that did not receive supplemental vitamin A. The mean blood plasma vitamin A concentrations were 22.15 γ per 100 ml. for the control group and 17.45 γ per 100 ml. for the vitamin A group. This difference was significant. The mean blood plasma carotene concentrations were 874 γ per 100 ml. for the control group and 696 γ per 100 ml. for the vitamin A group. This difference was highly significant.

Feeding supplemental vitamin A had no effect upon the blood plasma inorganic calcium and phosphorus concentrations of the heifers. In the preliminary experiment there were no significant differences between the two groups; however, both groups had higher blood plasma inorganic calcium concentrations and lower blood plasma inorganic phosphorus concentrations during the summer pasture period than during the feeding trial. In the main experiment there was no significant difference in the blood plasma inorganic calcium concentrations of the two groups of heifers, but the control group had a higher (highly significant) mean blood plasma inorganic phosphorus concentration than the vitamin A group. Too much emphasis must not be placed upon this, however, since the control group had a higher mean blood plasma inorganic phosphorus concentration than the vitamin A group at the start of the trial.

CONCLUSIONS

Feeding an average of 40,400 USP units of supplemental vitamin A per day to Holstein heifers receiving a normal ration resulted in no increase in the rate of growth. Increasing the vitamin A supplement to an average of 129,400 USP units per day in addition to the 114,000 USP units supplied daily in the basal ration resulted in a significant increase in body weight gains of Holstein heifers.

Feeding supplemental vitamin A significantly increased the blood plasma vitamin A concentrations and decreased the blood plasma carotene concentrations of Holstein heifers.

Blood plasma inorganic calcium and phosphorus concentrations were not altered by feeding supplemental vitamin A.

REFERENCES

(1) Boyer, P. D., Phillips, P. H., Lundquist, N. S., Jensen, C. W., and Rupel, I. W. Vitamin A and Carotene Requirements for the Maintenance of Adequate Blood Plasma Vitamin A in the Dairy Calf. J. Dairy Sci., 25(5): 433–440. 1942.

(2) Boyer, P. D., Phillips, P. H., and Smith, J. K. The Separation of Carotene from Vitamin A in Blood Plasma. J. Biol. Chem., 152: 445–452. 1944.

(3) Clark, E. P., and Collip, J. B. A Study of the Tisdall Method for the Determination of Blood Serum Calcium with a Suggested Modification. J. Biol. Chem., 63: 461–464. 1925.

(4) Gomori, G. A Modification of the Colorimetric Phosphorus Determination for Use with the Photoelectric Colorimeter. J. Lab. Clin. Med. 27(7): 955–960. 1942.

(5) Jones, J. R., and Haag, J. R. Vitamin A for Growth and Reproduction in Dairy Heifers. J. Dairy Sci., 21(5): 115–116. 1938.

(6) KEYES, E. A., BECHDEL, S. I., AND THORP, W. T. S. The Effect of Additional Vitamins A and D in the Standard Calf Starter (Abstract). J. Dairy Sci., 26(8): 741–742. 1943.

(7) KIMBLE, M. S. The Photoelectric Determination of Vitamin A and Carotene in Human Plasma. J. Lab. Clin. Med., 24: 1055–1065. 1939.

(8) MOORE, L. A. The Determination of Blood Plasma Carotene in the Bovine Using a Photoelectric Colorimeter. J. Dairy Sci., 22(7): 501–511. 1939.

(9) MOORE, L. A., AND ELY, R. Extraction of Carotene from Plant Material. Ind. Eng. Chem., Anal. Ed., 13: 600–601. 1941.

(10) SNEDECOR, G. W. Statistical Methods. The Iowa State College Press, Ames. 1946.

ASSOCIATION ANNOUNCEMENT

COLLEGIATE STUDENTS' INTERNATIONAL CONTEST IN JUDGING DAIRY PRODUCTS

Atlantic City, N. J.—October 25, 1948

Teams from twenty-six State Agricultural Colleges, participated in this, the fourteenth annual contest sponsored by the Dairy Industries Supply Association, Inc., and the American Dairy Science Association.

Following is a list of those who won high standings in the Contest:

ALL PRODUCTS

Individuals

1. Donald R. Moore, Michigan State College
2. Donald H. Pflueger, Iowa State College
3. W. E. Shiffermiller, Ohio State University
4. William H. Hoagland, University of Connecticut
5. Richard E. Lewis, Ohio State University
6. John N. Lewis, Ohio State University
7. Charles H. Fitch, Iowa State College
8. Lester Hankin, University of Connecticut
8. N. V. Kennedy, Mississippi State College
10. Arnold D. Nelson, Iowa State College

Teams

1. Iowa State College
2. Ohio State University
3. Michigan State College
4. Mississippi State College
5. University of Tennessee
6. University of Connecticut
7. University of Maryland
8. University of Massachusetts
9. Pennsylvania State College
10. Cornell University

BUTTER

Individuals

1.	Donald H. Pflueger, Iowa State College	4.33
2.	Donald R. Moore, Michigan State College	8.17
3.	William H. Hoagland, University of Connecticut	9.00
4.	William C. Flynt, Jr. Mississippi State College	10.42
5.	Delmer A. Boyce, University of Tennessee	11.50
6.	Charles H. Fitch, Iowa State College	11.75
7.	Harold McCracken, University of Tennessee	11.84
8.	William R. Vial, Purdue University	12.25
9.	Richard E. Lewis, Ohio State University	12.67
10.	John N. Lewis, Ohio State University	13.50

Teams

1.	Iowa State College	34.58
2.	Ohio State University	39.84
3.	Mississippi State College	41.92
4.	Michigan State College	42.34
5.	University of Tennessee	43.51
6.	University of Connecticut	44.00
7.	Purdue University	50.59
8.	University of Nebraska	53.34
9.	North Carolina State College	56.25
10.	Cornell University	57.25

CHEESE

Individuals

1.	William J. Deisley, Pennsylvania State College	28.17
2.	John N. Lewis, Ohio State University	28.59
3.	Arnold D. Nelson, Iowa State College	29.50
4.	Donald R. Moore, Michigan State College	29.75
5.	Ralph Whitehead, Michigan State College	31.25
6.	Harold A. Newlander, Cornell University	31.34
7.	Henry H. Sprowls, Texas Tech.	33.00
8.	Donald H. Pflueger, Iowa State College	33.09
9.	Robert J. Schutrumpf, University of Maryland	33.43
10.	M. V. Kennedy, Mississippi State College	33.50

Teams

1.	Michigan State College	94.84
2.	Iowa State College	98.09
3.	Cornell University	100.50
4.	Ohio State University	102.35
5.	Texas Tech.	106.85
6.	Mississippi State College	110.34
7.	University of Tennessee	111.18
8.	University of Illinois	112.58
9.	University of Connecticut	117.50
10.	Purdue University	120.52

ICE CREAM

Individuals

1.	Donald H. Pflueger, Iowa State College	29.00
2.	John A. McLeod, Jr. North Carolina State College	31.51
3.	Ralph Whitehead, Michigan State College	32.00
4.	W. E. Shiffermiller, Ohio State University	33.00
5.	Donald R. Moore, Michigan State College	33.50
6.	George H. Brink, University of Tennessee	34.50
6.	Roland I. Zeller, University of Minnesota	34.50
8.	Lester Hankin, University of Connecticut	35.00
8.	William H. Hoagland, University of Connecticut	35.00
10.	Delmer A. Boyce, University of Tennessee	35.50

Teams

1.	University of Tennessee	108.50
2.	Iowa State College	110.00

3.	Ohio State University	111.50
4.	University of Minnesota	114.00
5.	Pennsylvania State College	116.00
6.	Michigan State College	117.00
7.	University of Connecticut	118.50
8.	University of Nebraska	119.50
9.	University of Massachusetts	127.17
10.	University of Maryland	129.00

MILK

Individuals

1.	William J. Deisley, Pennsylvania State College	14.92
2.	Arnold D. Nelson, Iowa State College	20.45
3.	Dan Guyer, Oklahoma A. & M.	22.00
4.	Luther O. Meadows, Mississippi State College	23.25
5.	William H. Hoagland, University of Connecticut	23.95
5.	Donald R. Moore, Michigan State College	23.95
7.	W. E. Shiffermiller, Ohio State University	24.35
8.	Richard E. Lewis, Ohio State University	25.20
9.	Charles D. Spencer, University of Maryland	25.35
9.	Alan D. Young, University of Massachusetts	25.35

Teams

1.	Iowa State College	76.43
2.	Ohio State University	78.45
3.	Pennsylvania State College	81.42
4.	University of Maryland	85.70
5.	University of Massachusetts	86.37
6.	Mississippi State College	86.90
7.	University of Connecticut	88.65
8.	Michigan State College	90.83
9.	Oklahoma A. & M.	93.87
10.	University of Illinois	94.92

MEMBERS AND STUDENT AFFILIATES OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

November 1, 1948

Honorary Members:

BORLAND, A. A., 310 S. Burrowes St., State College, Pa.
FRANDSEN, J. H., Mass. State College, Amherst
GUTHRIE, E. S., Cornell Univ., Ithaca, N. Y.
HAYDEN, C. C., Ohio Agr. Expt. Sta., Wooster
HUNZIKER, O. F., 103 Seventh Ave., La Grange, Ill.
MORTENSEN, MARTIN, Iowa State College, Ames
REED, O. E., Bureau of Dairy Ind., U.S.D.A., Washington 25, D. C.

Life Members:

BREED, ROBERT S., 6 Sunset Drive, Geneva, N. Y.
HARDING, H. A., Baileys Harbor, Wis.
HASTINGS, E. G., Univ. of Wisconsin, Madison
LARSEN, DEAN CHRIS, S. Dak. State College, Brookings
LARSON, C. W., Tudor Plaza Apts., 741 W. Ferry St., Buffalo, N. Y.
ROGERS, L. A., 3635 S Street, N. W., Washington 7, D. C.
ROSS, H. E., Cornell Univ., Ithaca, N. Y.
WHITE, GEORGE C., Willowbrook Rd., Storrs, Conn.

ALABAMA

Members:

AUTREY, KENNETH M., Dept. of Dairy Husb., Ala. Polytechnic Inst., Auburn
BURKE, A. D., Dept. of Dairy Husb., Ala. Polytechnic Inst., Auburn
CANNON, ROBERT Y., Dept. of Dairy Husb., Ala. Polytechnic Inst., Auburn
EATON, W. H., Dairy Dept., Ala. Polytechnic Inst., Auburn
DAVIS, J. W., c/o County Agent, Gadsden
FRANKLIN, V. D., Rt. 2, Box 105, Birmingham 9
*HOWLE, HENRY W., Deep South Creamery, Cullman
KIRCHOFF, GEORGE, Bureau of Food Insp., Dept. of Health, Birmingham
PARRISH, J. B., Ext. Dairyman, Ala. Polytechnic Inst., Auburn
TEAGUE, C. E., 1010 Brown Marx Bldg., Birmingham
WARREN, F. G., Dept. of Dairy Husb., Ala. Polytechnic Inst., Auburn
WIDEMIRE, E. L., Sylacauga

Student Affiliates:

BRYARS, c/o College Creamery, Auburn
CAPPS, HENRY, Rt. 2, Opelika
CHATHAM, JOHN H., Pine Milk Co., Inc., Brewton
EAGERTON, HERBERT JR., Rt. 4, Box 500, Montgomery
ETHERIDGE, BILL, 351 N. Gay, Auburn
JACKSON, H. B., 247 E. Thatch, Auburn
KOHN, HERBERT, 220 W. Magnolia, Auburn
PATTERSON, J. W., 115 S. 4th St., Opelika
ROGERS, CALVIN, Alpha Gamma Rho House, Auburn
THOMAS, WILLIAM H., Foremost Dairies, Inc., Marion
WARRINGTON, JAMES, 113 S. Norton Ave., Sylacauga

ARIZONA

Members:

AGETON, RICHARD V. JR., Ariz. Flour Mills Co., Box 5048, Tucson
BANKS, A. E., Box 156, Glendale
BRAMHALL, ERVIN L., P.O. Box 751, Phoenix
CRUMBAKER, JAMES W., P.O. Box 394, Tempe
DAVIS, R. N., College of Agr., Tucson
EWING, JAMES W. JR., Rt. 5, Box 162, Tucson
HARLAND, F. G., Hopi Lodge, Univ. of Ariz., Tucson
*RASKOB, J. J. JR., Rt. 5, Box 226, Tucson
ROBERTS, LUCIUS E. JR., 2025 Oracle Rd., Tucson
RUST, PHILIP F., Rt. 2, Box 412, Phoenix
VAN SANT, W. R., Agr. Ext. Serv., Univ. of Ariz., Tucson

ARKANSAS

Members:

GARRISON, EARL R., Dept. of Animal Ind., Univ. of Ark., Fayetteville
GIFFORD, WARREN, Dept. of Animal Ind., Univ. of Ark., Fayetteville
*HEAD, T. P., 222 Gray Hall, Univ. of Ark., Fayetteville

*—New Members

*HOLLEY, A. LEON, 222 Gray Hall, Univ. of Ark., Fayetteville
*MEADOWS, CLIFTON E., Box 693, Fayetteville

Student Affiliates:

ELKINS, L. C., Junction City
YARNELL, ALBERT, c/o Yarnell Ice Cream Co., 205 S. Spring St., Searcy

CALIFORNIA

Members:

AHLSTROM, WALTER, 1965 Euclid Ave., San Marino
ANDERSEN, MRS. VIVIAN GRACE, 1317 36th St., Sacramento
*BAIRD, HARRY S., 1220 Dover Rd., Santa Barbara
*BATCHELDER, D. T., Agr. Ext. Serv., Univ. of Calif., Berkeley
BECKLEY, MAURICE S., Room 201, P.O. Bldg., San Jose 18
BESEMER, A. M., 1340 St. Charles St., Alameda
BEVER, ELDRIDGE, 1403 Country Club Blvd., Stockton
BROCKMEYER, G. H., 1806 Quito Way, La Canada
BRUECKNER, HERMAN J., 18 Manor Drive, Piedmont 11
BRUNNER, THEO, 244 Fairfield Rd., N. Sacramento
CHRISTENSEN, SOREN, 2847 Stoddard St., San Bernardino
CLARY, PAUL D. JR., Rt. 3, Box 294, Petaluma
CLEMONS, HARPER B., 5425 Brynhurst Ave., Los Angeles 43
COLE, H. H., Div. of Animal Husb., College of Agr., Davis
COLE, WILFORD C., c/o Arden Farms, Inc., Research Lab., 1900 W. Slauson Ave., Los Angeles
DETURK, L. E., 3845 Butler Ave., Fresno
DEY, MARCUS, Golden State Co., Ltd., 1120 Towne Ave., Los Angeles 21
DREYER, WM. A. JR., 5929 College Ave., Oakland
*DUNCAN, JAMES F., 1562 Waller St., San Francisco 17
DUNKLEY, W. L., Dir. Dairy Prod., Univ. of Calif., Davis
*ELLISON, HOWARD, 1639 N. Main St., Los Angeles 12
ENGLE, BRUCE Q., 6418 California St., San Francisco 21
FASSETT, W. W., 3949 E. Pacific Ave., Sacramento
FOLEY, DAN, P.O. Box 1391, Vallejo
FREIDEL, EDW. H., Arden Farms Co., Patterson
FULLER, STEWART A., P.O. Box 6, Eureka
GARDNER, MORRIS A., 3631 Pomeroy St., Los Angeles 33
GORDON, G. E., 8 Giannini Hall, Univ. of Calif., Berkeley
*GORHAM, CLINTON C., 701 Clark St., Yuba City
GREENE, SAM H., 1570 Third Ave. N., Walnut Creek
HANSEN, ELMER N., 1331 Pacific, San Luis Obispo
*HANSEN, VERNON, Crystal Cream & Butter Co., 1013 D St., Sacto
HARDISON, RUSSELL D., Rte 2, Box 264, Fillmore
HASLER, GEORGE L., 118 Peralta Way, Fresno 4
HAWKINS, ERVIN, 6601 Santa Monica Blvd., Los Angeles 38
HENDERSON, J. LLOYD, Golden State Co., Ltd., San Francisco 11
HEYL, RICHARD E., 2511 Webster St., Palo Alto
HOECKER, WESLEY H., Golden State Co., 425 Battery St., San Francisco 11
*HUBBELL, BRUCE JR., 315 B St., Davis
HUEBSCH, HAROLD, 3615 Jewell, San Diego
ILG, GEORGE F., Borden's, H. & Tuolumne St., Fresno
JACK, E. L., Div. of Dairy Ind., Univ. of Calif., Davis
*JAMISON, EUGENE O., Rt. 1, Box 344, Visalia
JOHNSON, HOWARD L., 2598 Elm Ave., Fresno
JONES, ROBERT E., c/o Pacific Dairy Review, 500 Sansome St., San Francisco
KOHLER, ROLAND, 2320 Richelieu Ave., Los Angeles 32
KREHBIEL, LEONARD F., 3720 Hughes Ave., Los Angeles 34
*LACHMANN, ALFRED, 217 Second St., Davis
LAMPERT, L. M., P.O. Box 1266, Sacramento
LEVITAN, MEYER, 1354 Wright St., Los Angeles 15
LOFGREEN, G. P., Univ. of Calif., Davis
MACKENZIE, F. B., Albers Milling Co., 6130 S. Aralon Blvd., Los Angeles 3
*MCCORMICK D. R., Avoset Co., Gustine
MCFARLAND, G. G., Div. of Milk Insp., Los Angeles County Health Dept., 808 N. Spring St., Los Angeles
MEAD, SYLVESTER W., c/o Agr. Expt. Sta., Davis
MENZIES, VERNON H., Newman
MILNER, F. W., 204 State Bldg., Los Angeles
MOJONNIER, ROBERT W., 323 E. Foothill Blvd., Altadena
MORGAN, NORMAN C., 1822 Valley Blvd., Rosemead
MORRISON, SPENCER H., 1110 Fourth St., Davis
MUDGE, COURTLAND S., Univ. Farm, Davis
NELSON, VICTOR, Central Research Dept., Food Machinery Corp., San Jose
PAINTER, W. E., 1949 Third Ave., Sacramento
PEEBLES, DAVID D., c/o Western Condensing Co., 411 Battery St., San Francisco

PHILLIPS, CLEMENT A., Univ. of Calif., Davis
RAFFETTO, LLOYD A., Placerville
RALSTON, NOEL, Animal Husb. Dept., Univ. of Calif., Davis
REGAN, W. M., Agr. Expt. Sta., Davis
ROADHOUSE, C. L., Univ. of Calif., Davis
ROLEN, WALLACE, Manteca
RUSSELL, O. M., Box 908, Los Banos
SCARAMELLA E. L., 2660 Newhill St., San Francisco 24
SHAMBERGER, DAN, 1161 Irvin, Belmont
SHARP, PAUL F., 20 Bellevue Ave., Piedmont 11
SHELDON, F. M., 1097 S. Marengo Ave., Pasadena 2
SHIPSTEAD, HELGE, Div. of Dairy Ind., Univ. of Calif., Davis
SPERRY, G. D., 3425 Wallace, San Diego 10
SPRAGUE, WILLIAM HERBERT, Rt. 2, Box 232, Healdsburg
STABILE, JOSEPH N., 406th Med. Gen. Lab. A.P.O. 500, c/o P.M., San Francisco
*STACHWICK, ROBERT, 5338 Brooklyn Ave., Los Angeles
STEELE, EARL, 2660 Newhall St., San Francisco 24
STEWART, AUBREY P. JR., Golden State Co., 425 Battery St., San Francisco
STOCKLIN, PAUL, Challenge Cream & Butter Assn., 929 E. Second St., Los Angeles 12
TARASSUK, N. P., Dairy Ind. Div., Univ. of Calif., Davis
TELFORD, HAROLD R., 841 Cross St., Tulare
TRANMAL, HENRY, c/o Arden Farms Co., 1900 W. Slauson Blvd., Los Angeles
TURNBOW, G. D., 1106 Broadway, Oakland 7
VON LANGE, OSCAR, Borden's Dairy Delivery Co., Soledad
WELCH, JAMES D., 2922 Madera Ave., Oakland
WETMORE, E. L., 305 N. Wilson Ave., Modesto
YALE, M. W., Arden Farms Co., Patterson
YOUNG, GEORGE D. JR., 4401 18th St., San Francisco 14

Student Affiliates:

ADAMSON, MERRITT, JR., P.O. Box 277, Davis
COPPES, JOHN G., Aggie Villa F-5, Davis
COX, RAYMOND C., J. 2, Aggie Villa, Davis
FERGUSON, CLARK G., 215 E. 4th St., Madera
FLORA, CHARLES P., Rt. 2, Box 354 G., Manteca
HSUEH, TEH-YING, Room 108, South Hall, Davis
HUD, JOE, 311 S. 14th St., San Jose
MAHSHI, GEORGE J., 2328 Edward St., Berkeley 2
NAVA, LOUIS J., 1 San Pedro Rd., Colima 25
SPEIZER, MARK, 27 Santa Ana Ave., Belmont Shore
SPENCE, NORVIN R., 10011, Stanford Ave., South Gate
SQUIBB, R. L., c/o M. R. Papson, Lakeport
TEIXEIRA, JOHN A., College of Agr., Davis

CANADA

Members:

ATKINSON, L. A., Fraser Valley Milk Prod. Assn., 425 8th Ave. W., Vancouver, B. C.
BAKER, JAMES L., 20 Windley Ave., Toronto 10, Ontario
*BELANGER, GEORGE, Dairy School, St. Hyacinthe, Quebec
BERRY, JOHN C., Dept. of Animal Husb., Univ. of British Columbia, Vancouver, B. C.
BIRD, W. J., Dairy Supr., Nova Scotia Agr. College, Truro, N. S.
BONNER, ROY, Ingersoll, Ontario
BREMNER, JAMES, Room 205, 749 Yonge St., Toronto
BROWN, R. W., Univ. of Manitoba, Fort Garry Site, Winnipeg, Manitoba
CAMIRAND, ROLAND, Dept. of Agr., Hotel du Government, Quebec
CHAMBERLAYNE, E. C., Dir. of Food & Milk Control, 320 Sherbrook St., Winnipeg, Manitoba
CRABTREE, GEORGE H., Box 372, Abbotsford, B. C.
DARCH, JOHN KENNETH, c/o S. F. Lawrason & Co. Ltd., 639 Nelson St., London
GIBSON, A. L., Eastern Dairy School, Kemptville, Ontario
HANSON, R., 10105 82nd Ave., Edmonton, Alberta
HODGINS, C. L., 100 Adelaide St. W., Toronto, Ontario
HOOD, E. G., Chief Dairy Research, Central Expt. Farm, Ottawa, Ontario
HOWE, J. W., Dept. of Animal Sci., Univ. of Alberta, Edmonton, Alberta
IRVINE, O. R., Ontario Agr. College, Guelph, Ontario
JACKSON, J. R., Simcoe, Ontario
JONES, W. J., Ottawa Dairy Ltd., Ottawa, Ontario
*KEAY, JOHN, 530 Public Bldg., Calgary, Alberta
KILLICK, C. H. P., Dept. of Agr., Winnipeg
LICHTER, MAX, Roblin, Manitoba
MAYBEE, G. R., Fry-Cadbury Ltd., 2025 Masson St., Montreal, Quebec
MCGEE, JOHN W., 45 Howard Park Ave., W. Toronto Creamery Prod., Toronto, Ontario
MERCIER, ERNEST, Quebec Artificial Breeding Center, St. Hyacinthe, Quebec
MOORE, P. H., Colony Farm, Essondale, B. C.
MORRISON, J. S., Borden Co., Ltd., Milk Prod. Div., Tillsonburg, Ontario

NESS, A.R., MacDonald College, Quebec
PEARSON, A. M., 69 Fairview Blvd., Guelph, Ontario
RAITHBY, GEORGE E., Animal Husb. Dept., Ontario Agr. College, Guelph, Ontario
REED, PERCY E., Dairy Commissioner, Dept. of Agr., Regina, Sask.
SINGLETON, J. F., Marketing Serv., Dairy Prod. Div., Dept. of Agr., Confederation Bldg., Ottawa, Ontario
SPROULE, W. H., Ont. Agr. College, Guelph, Ontario
*STARR, ARTHUR E., Canada Packers, Ltd., Produce Dept., 60 Paton Rd., Toronto, Ontario
STRYNADKA, NICHOLAS JOHN, c/o Dominion Dairy Produce, New Immigration Bldg., Edmonton, Alberta
THORNTON, H. R., Dept. of Dairy Husb., Univ. of Alberta, Edmonton, Alberta
WEBSTER, H. G., 90 Perry St., Woodstock, Ontario
WOOD, ROGER, 2448 Cambie St., Vancouver, B. C.
YATES, C. MONTAGU, Maxwelton Farm, St. Anne de Bellevue, Quebec

COLORADO

Members:

ALM, VERNE, 632 Martindale Drive, Denver
BEACH, F. LEONARD, 3521 Milwaukee, Denver
FRINK, EUGENE H., Unit 67, Room 4, Wazee Market, Denver
MCKELLAR, E. K., Dairy Dept., Colo. A & M College, Ft. Collins
MILLER, COL. M. M., Univ. of Denver, Univ. Park, Denver
MORTENSEN, O. L., 2145 Market St., Denver
POE, CHARLES F., Univ. of Colo., Boulder
REEVES, ROBERT H., Carlson-Frink Co., Denver
SANDHOUSE, H. A., Ext. Dairyman, Colo. State College, Ft. Collins
TESELLE, E. A., 2517 9th Ave., Greeley
WILLIAMS, E. B., Animal Husb. Dept., Colo. A & M College, Ft. Collins

Student Affiliates:

ABBOTT, J. W., 62 Mesa St., Vet Village, Ft. Collins
BAIRD, KENNETH A., 5512 Cherry Creek Dr., Denver
BALLOU, E. E., 309 Scott St., Ft. Collins
DILSAVER, HAROLD R., 332 Edwards, Ft. Collins
GARCIA, THOMAS J., Animal Husb. Dept., Colo. A & M College, Ft. Collins
MCCORKLE, LLOYD, Dept. of Animal Husb., Colo. A & M College, Ft. Collins
SELCH, R. P., Dept. of Animal Husb., Colo. A & M College, Ft. Collins
WIELAND, STANLEY, Dept. of Animal Husb., Colo. A & M College, Ft. Collins
WOLFE, ARDEN D., Dept. of Animal Husb., Colo., A & M College, Ft. Collins

CONNECTICUT

Members:

ANDERSON, E. O., Univ. of Conn., Storrs
ANDERSON, WILLIAM E., c/o Eastern States Farmers Exch., Westbrook Farm., R.D. 2, Rockville
CHAPMAN, LEROY M., 293 White St., Danbury 7
DAVIS, MYRON C., R.D. 1, Stafford Springs
DEMING, ROBERT N., Asst. County Club Agent, 215 P.O. Bldg., Danbury
DOWD, LEONARD R., Storrs
EATON, HAMILTON D., Animal Ind. Dept., Univ. of Conn., Storrs
FERRIGNO, FRANK F., 358 Jackson St., Wilmantic
FREEDMAN, MICHAEL, Box 331, Cheshire
GOLD, THEO. S., Cream Hill Farm, West Cornwall
HANSEN, HENRY M., Box U 40, Univ. of Conn., Storrs
JOHNSON, ROBERT E., Univ. of Conn., Storrs
MANN, ALBERT I., Dairy Dept., Univ. of Conn., Storrs
*MARLAND, RICHARD E., Univ. of Conn., Storrs
*MERCER, DONALD N., Box U 40, Univ. of Conn., Storrs
*MERRELL, GEORGE G., R.F.D. 1, Plainfield
MERRILL, A. R., Univ. of Conn., Storrs
NEUMANN, H. D., New Haven Dairy Div., General Ice Cream Corp., New Haven
SEREMET, JOHN S., 990 Wethersfield Ave., Hartford
SPIELMAN, ARLESS, Dairy Ind. Dept., Univ. of Conn., Storrs
WALKER, WILLIAM R., Dairy Div., Univ. of Conn., Storrs
WHITE, GEORGE C., Willowbrook Rd., Storrs
WHITHAM, G. E., R.F.D. 6, Norwich
WILLMANN, JOSEPH, Derby

Student Affiliates:

CURME, GEORGE O. III, Gerald Park, R.R. 1, South Coventry
MORGAN, MAX, Dept. of Animal Ind., Univ. of Conn., Storrs

DELAWARE

Members:

BAKER, THOMAS A., Univ. of Del., Newark
YOUNG, DELMAR, Dairy Ext. Office, Univ. of Del., Newark

District of Columbia

Members:

Babcock, C. J., 3700 Cumberland St. N.W.
Bain, J. B., 1302 Geranium St. N.W.
Bell, R. W., 4409 Greenwich Pkway
Bletch, Chester T., 1756 K St. N.W.
Burkey, L. A., Bureau of Dairy Ind., U.S.D.A.
Castle, Benjamin F., 1001 15th N.W.
Cruise, Chestnut Farm Dairy
Davison, Maurice V., 2535 Pennsylvania Ave. N.W.
Elting, E. C., Office of Expt. Sta., U.S.D.A.
Everett, Roberts, Albee Bldg., 1426 G St. N.W.
Fohrman, M. H., U.S.D.A., Bureau of Dairy Ind.
Gamble, J. A., 4622 S. Dak. Ave. N.E.
Hibben, Robert C., Int. Assn. of Ice Cream Mfgrs., 1105 Barr Bldg.
Holm, G. E., Bureau of Dairy Ind., U.S.D.A.
Holman, Charles W., 1731 Eye St. N.W.
Jamison, Orville A., 5024 9th St. N.W., Apt. 303
Kendrick, J. F., Bureau of Dairy Ind., U.S.D.A.
*Krey, Charles E., Southern Dairies, Inc., 60 M St. N.E.
Lefevre, P. E., 2535 Penn. Ave. N.W.
Lochry, H. R., Bureau of Dairy Ind., U.S.D.A.
MacDonald, Alexander, Dairy Labs., 1717 N. Capital St.
Malkemas, James P., Bureau of Dairy Ind., U.S.D.A.
Manovill, Robert John, Dairy Ind. Society, Albee Bldg.
Nystrom, A. B., Bureau of Dairy Ind., U.S.D.A.
Parker, Joseph B., Dairy Husbandman, Agr. Research Adm., Bureau of Dairy Ind., U.S.D.A.
Reed, O. E., Bureau of Dairy Ind., U.S.D.A.
Rogers, L. A., 3635 S St. N.W.
Sanders, George P., Bureau of Dairy Ind., U.S.D.A.
Swett, Walter W., Bureau of Dairy Ind., U.S.D.A.
Trimble, Charles S., 1443 Holly St. N.W.
Webb, B. H., Bureau of Dairy Ind., U.S.D.A.
Whittier, E. O., Bureau of Dairy Ind., U.S.D.A.
Wintermeyer, W. E., Bureau of Dairy Ind., U.S.D.A.
Work, S. H., Office of Expt. Sta., U.S.D.A.
Wright, Philip A., Bureau of Dairy Ind., U.S.D.A.

Student Affiliates:

Klosky, Henry S., 1234 Otis St.
Mucha, T. J., Bureau of Dairy Ind., U.S.D.A.
Spencer, Charles D., 1901 Wyoming Ave. N.W.

Florida

Members:

*Addington, Rogers W., 1001 Washington St., P. O. Box 3297, Tampa
Arnold, P. T., Animal Husb. Dept., Univ. of Fla., Gainesville
Arrington, Lewis R., Dairy Prod. Lab., Univ. of Fla., Gainesville
*Bassett, Curry J., P. O. Box 783, Tallahassee
Becker, R. B., Animal Ind. Dept., Univ. of Fla., Gainesville
*Bowen, J. O., Southern Dairies, Inc., 62 N. E. 27th St., Miami 31
Bulmer, L. C., 670 63rd Ave., S., St. Petersburg 5
Dressel, R. L., Dressel's Dairy Farm, P. O. Box 1656, Riverside Sta., Miami 35
*DuPuis, John G. Jr., P. O. Box W, Little River Sta., Miami 38
Fogg, E. C. III, 101 Alton Rd., Miami Beach 39
Fouts, Everett L., Dairy Prod. Lab., Fla. Agr. Expt. Sta., Gainesville
Hammer, B. W., 369 W. Arlington Ave., Sarasota
Hastings, E. G., Rt. 3, Box 456, Orlando
Josephson, Warren A., 2721 Southwood Lane, Jacksonville
Krehl, W. H., 924 Huron St., Jacksonville 5
Krienke, Walter A., Univ. of Fla., Gainesville
Marshall, Sidney P., Animal Ind. Dept., Univ. of Fla., Gainesville
*Mull, Leon E., Dairy Prod. Lab., Univ. of Fla., Gainesville
Neal, Wayne M., c/o Jackson Grain Co., P.O. Box 1290, Tampa 1
Parsons, C. H., 3613 W. Platt St., Tampa
Reaves, C. W., Ext. Dairyman, Univ. of Fla., Gainesville
*Scribner, L. A., City Hall, Orlando
*Shealy, A. L., Animal Ind. Dept., Univ. of Fla., Gainesville
*Solomon, S. H., c/o Solomon's Dairy, Quincy
Stoy, Charles O., Dade County Health Unit, 800 Court House, Miami
*Tripson, John Robert, Vero Beach Dairies, Vero Beach
Tworoger, George, Box Q, Little River Sta., Miami
Ulvin, Gus B., Penney Farms, Box 8
Williams, N. Kenneth, P.O. Box 142, Ft. Pierce
Wrenshall, C., Foremost Dairies, Inc., 53 W. Ashley St., Jacksonville

Student Affiliates:

Albert, Luther T., P. O. Box 2362, Univ. Sta., Gainesville

CAMMACK, ELBERT, 103 N. Hillside, Orlando
DUDLEY, JAMES R., Flavet 3, Apt. 212D, Gainesville
EDWARDS, OTHO W. JR., 214 Washington St., Gainesville
HINDEREY, GEORGE A., General Delivery, Plant City
LANEY, WILLIAM A., 5506 Seminole Ave., Tampa 4
MINEAR, LAIRD, Jupiter
NOLES, S. O., 934 2nd Ave., Gainesville
SCHOENBERGER, FRED L., 427 Colson St., Gainesville
UZZELL, EARL M., Alpha Gamma Rho, Gainesville
WEAVER, C. A., Boynton Beach

GEORGIA

Members:

*BONAR, HENRY, Moultrie
*BRYAN, WILLIAM G., c/o Rosemary Creamery, 62 Baltimore Pl. N.W., Atlanta
CALLAWAY, FULLER E. JR., Hills & Dales, LaGrange
*CLARK, GEORGE J., Cols. Field Training Sta., Muscogee County, Health Dept., Columbus
COARSEY, RALPH W., Riegeldale Farm, Trion
*DEHART, G. H., Dept. of Health, 815 Hemlock St., Macon
*GAY, JAMES D., 661 Whitehall St., Atlanta
*HAMILTON, BRUCE, Ext. Serv., Univ. of Ga., Athens
HARRIS, J. J., Pelham
*HARRIS, L. A., Asst. County Agent, Wilkes County, Washington
*HAWKINGS, GEORGE E. JR., Dairy Dept., Univ. of Ga., Athens
*HAWKINS, JOE K., 314 Main St., LaGrange
HENDERSON, H. B., Dairy Dept., Univ. of Ga., Athens
JACKSON, JAMES E., 414 Hurt Bldg., Atlanta 3
*IVEY, BERNARD E., Tri-County Health Dept., Toccoa
*KEMP, HENRY L., Cowetta Coop. Dairies, Newnaw
KING, LEVI J., 144 Hedges St., Marietta
*KINGSLEY, GLENN P., Box 192, Rossville
MASSEY, Z. A., Ga. Expt. Sta., Experiment
*MECH, A. W., Kraft Foods Co., 890 Memorial Dr. S. E., Atlanta
NEILL, KEN A., 2313 Bell St., Columbus
*REESE, CHARLES F., Southern Dairies, Inc., Atlanta
SANCKEN, GEORGE A., Box 710, Augusta
SHEURING, JOHN J., Dept. Dairy Husb., Univ. of Ga., Athens
SOUTHWELL, B. L., Ga. Coastal Plain Expt. Sta., Tifton
STRATTON, JAY W., Washington
WARD, C. A., Rucliff Farm, R.F.D. #3, Athens
*WEISSMAN, HARRY, U.S. Penitentiary, Atlanta
WELLS, BERT H., The Coca-Cola Co., P.O. Box 1734, Atlanta
WELLS, L. T., 591 E. Morningside, Atlanta
WILSON, WILLIAM L., Wilson Dairy Prod., 657 E. Lake Dr., Decatur

Student Affiliates:

AMOS, WILLIAM G., Monticello
ARRENDALE, JOHN V. JR., Dairy Dept., Univ. of Ga., Athens
ASH, BILLY, County Agent's Office, Ringgold
BAGWELL, JAMES R., Fain Hall, Box 357, Athens
BANISTER, ANDREW, Fain Hall, Ag. Hill, Athens
BIBLE, EDWARD JACKSON JR., 1280 Lumpkin St., Athens.
BLACK, ROY, Lithia Springs
BRANNON, WILLIS W. JR., Ag. Hill Center, Box 589, Athens
BREEDLOVE, ROYCE A. JR., Ag. Hill Center, Box 520, Athens
BRYANT, CHALMER, Independence Hall, Ag. Hill, Athens
COLEVINS, C. J., 448 Connally St. S.E., Atlanta
COLVARD, THOMAS W., Box 185, Ag. Hill Center, Athens
CONNER, JOHN SIDNEY, R.F.D. 1, Monroe
COPELAN, CHARLES L., R.F.D. 1, Greensboro
COPELAND, JIMMY, Independence Hall, Ag. Hill, Athens
DAVENPORT, FORREST, Hemp
DEAL, JAMES F., Dairy Dept., Univ. of Ga., Athens
DORRIS, FRANK P., Independence Hall, Ag. Hill, Athens
DOWNER, ROBERT RUCKER, Independence Hall, Ag. Hill, Athens
FIELD, JOHN H., Ag. Hill Center, Box 116, Athens
FINCHER, HORACE L., Fair Haven, Athens
FOLDS, GEORGE R., Candler Hall, Athens
GIBBS, THOMAS A., Bostwick
GRIFFIN, GEORGE R., P.O. Box 85, Madison
HENDERSON, PETER L., 480 Stanton Way, Athens
HOLLIMAN, GEORGE M., Warrenton
HUNNICUTT, GEORGE LYLE, Griggs Hall, Ag. Hill, Athens
KNOX, JOE C., Griggs Hall, Ag. Hill, Athens
LEE, DARWIN H., Griggs Hall, Ag. Hill, Athens
LEE, JOSEPH WM. JR., Box 163, Ag. Hill, Athens
MCCLENDON, WILLIAM A. JR., Ag. Hill Center, Box 30, Athens

McGOWAN, JOHN E., Ag. Hill Center, Box 210, Athens
MOORE, STATEN M., 1295 Lumpkin St., Athens
MORGAN, JACKSON D., 320 S. Lumpkin St., Athens
MYERS, FRED, P.O. Box 76, Marietta
PORTER, W. L., R.F.D. #2, Martin
PRESCOTT, JAMES JR., 663 N. Milledge Ave., Athens
QUARLES, THOMAS D., R.F.D., Ball Ground
SISSON, WILLARD, Independent Hall, Ag. Hill, Athens
STEWART, CHARLES, c/o Troy Rucker, Alpharetta
SUTTON, BAKER N., Rt. 1, Norman Park
THOMPSON, TOMMY L., 663 N. Milledge St., Athens
WALKER, CHARLES, 199 Bloomfield St., Athens
WEBB, JOE T., 397 W. Southview Dr., Athens

HAWAII

Members:

BURNETT, CHARLES H., JR., Puunene Maui
HENKE, L. A., Agr. Expt. Sta., Univ. of Hawaii, Honolulu
*VOLLRATH, HARVEY M., 1548 Wilder Ave., Honolulu

Student Affiliates:

CHING, HAROLD T. C., 2825 Nuuanu Ave., Honolulu

IDAHO

Members:

ANDERSON, G. G., State House, Boise
BOYD, JAMES CECIL, Dairy Husb. Dept., Univ. of Idaho, Moscow
BUCK, CHARLES, 119 S. 1st W., Rexburg
FOURT, D. L., Dairy Husb. Dept., Univ. of Idaho, Moscow
HANSEN, HENRY C., Dairy Husb. Dept., Univ. of Idaho, Moscow
MANWARING, D. H., Banquet Better Foods, Nelson-Ricks Creamery, Rexburg
ROSS, RICHARD H., Dairy Husb. Dept., Univ. of Idaho, Moscow
*SLATER, I. W., 1208 Owyhee St., Boise
THEOPHILUS, D. R., Dairy Husb. Dept., Univ. of Idaho, Moscow
TRASK, E. S., Upper Snake River Valley Dairymen's Assoc., Inc., Box 501, Idaho Falls

Student Affiliates:

BRETZ, JOHN, Dairy Husb. Dept., Univ. of Idaho, Moscow
COPENHAVER, HOWARD V., Dairy Husb. Dept., Univ. of Idaho, Moscow
EYESTONE, ROBERT D., Dairy Husb. Dept., Univ. of Idaho, Moscow
GREEN, WAYNE, 1517 S. 4th Ave., Pocatello
JAUSSI, FERD G., Paris
PLATO, NICK, Dairy Husb. Dept., Univ. of Idaho, Moscow
RAWLS, JOHN V., 1619 N. 21st St., Boise
SENFTEN, EUGENE R., Dairy Husb. Dept., Univ. of Idaho, Moscow

ILLINOIS

Members:

ALBERTS, RAYMOND J., 327 Potomac Ave., Lombard
ALEXANDER, M. H., 120 Old Agr. Bldg., Univ. of Ill., Urbana
ANDERSON, J. A., 7656 Lafayette Ave., Chicago 20
ANDERSON, RALPH J., Sisalkraft Co., 205 N. Wacker Dr., Chicago
ARNOLD, LLOYD, 1538 E. 57th St., Chicago
BARNES, R. E., 327 W. Prairie, Marengo
BARON, MORRIS, 6606 S. Richmond St., Chicago Lawn, Chicago
BOARD, F. S., 162 E. Ohio, Chicago
BOBER, L. E., Babson Bros. Co., 2843 W. 19th St., Chicago
*BOYLE, REID G., 223 W. Park St., Edwardsville
BRIGGS, S. E., 20 N. Wacker Dr., Chicago 6
BROCK, JOHN H., Box 128, Dundee
BROWN, J. C., American Butter Inst., Room 1404, 110 N. Franklin St., Chicago
BROWN, W. CARSON, 100 Elmhurst Rd., Box 274, Prospect Heights
BRYANT, H. WAYNE, 234 W. Maple Ave., Stockton
BURROWS, O. K., Cherry-Burrell Corp., 427 Randolph St., Chicago
CARTER, E. B., Meadow-Gold Dairies, 302 S. Main St., Decatur
CHRISTIANSEN, C. VALDIMAR, 140 W. Ontario St., Chicago
CORBETT, W. J., 1724 Ridge Ave., Rockford
DARGER, HARRY C., 2022 Lincoln St., Evanston
DENNERLEIN, ARNO A., Quaker Oats Co., 141 W. Jackson Blvd., Chicago
DIAMOND, WM. T., Amer. Feed Mfgrs. Assoc., 53 W. Jackson Blvd., Chicago
EDMAN, GEORGE J., 703 E. Center St., Leroy
EISENSTEIN, NORMAN, 1263 Pratt Blvd., Chicago
ELDRED, R. E., A & P Tea Co., 211 W. Wacker Dr., Chicago
ELMSLIE, W. P., Moorman Mfg. Co., Quincy
*ENENBACH, HENRY J., 614 Washington, Carbondale
EPSTEIN, ALBERT K., 5 S. Wabash, Chicago

ERDMANN, H. H., 135 S. LaSalle St., Room 1425, Field Bldg., Chicago
EVENSON, MELVIN, Nauvoo Milk Prod. Co., Nauvoo
FAIRBANKS, B. W., American Dry Milk Inst., 221 N. LaSalle St., Chicago
FEDDERSON, R. E., 3931 S. Leavitt St., McKinley Park Sta., Chicago
*FELDMAN, SHELDEN, 2811 W. Division, Chicago 22
FENTON, F. E., 1102 New P.O. Bldg., Chicago 7
FIPER, RUSSELL, American Butter Inst., 110 N. Franklin St., Chicago
FLAKE, J. C., 138 E. The Lane, Hinsdale
FOX, WILLIAM K., 918 Hickory St., Waukegan
FRITZ, JAMES C., 22 Monroe St., Elgin
GAINES, W. L., 120 Davenport Hall, Univ. of Ill., Urbana
GARDNER, KARL, Dept. of Dairy Husb., Univ. of Ill., Urbana
GIBSON, GILBERT G., 10541 Drew St., Chicago 43
GILLESPIE, DALE, 1243 W. Washington Blvd., Chicago
GOODMAN, MARK C. JR., Goodman American Corp., Federal at 45th St., Chicago
GOTHARD, F. THOMAS JR., 208 N. Romini St., Urbana
GRAHAM, T. W., Allied Mills, Inc., 210 Suffern Bldg., Decatur
GRANDISON, EDWARD G., Swift & Co., Union Stock Yards, Chicago
*GREENSPAN, JOSEPH, Consolidated Products Co., 119 N. Washington Ave., Danville
GUNDERSON, N. O., 8th Floor, City Hall Bldg., Rockford
HAMAN, ROBERT W., The Wander Co., Villa Park
HARRIMAN, L. A., Armour Research Labs., Union Stock Yards, Chicago
HARRIS, J. L., 1008 North Ave., Waukegan
HARSHBARGER, K. E., 120 Davenport Hall, Univ. of Ill., Urbana
HEMB, D. M., 3659 Harrison St., Chicago
HENRY, DAVID H., Prairie Farms Creamery, 43 E. Ohio St., Chicago 11
HERREID, ERNEST, Dairy Husb. Dept., Univ. of Ill., Urbana
HETRICK, J. H., Dean Milk Co., Rockford
HOEGER, VERNON C., Box 792, Warrenville
HORRALL, B. E., 6759 S. Oglesby, Chicago
*HOYT, RICHARD M., 807 S. Main St., Normal
HUFFER, ENOS G., 1328 Noble Ave., Springfield
HULL, MAURICE E., 230 S. Catherine Ave., LaGrange
HUNNICUTT, W. D., Natl. Dairy Prod. Co., Inc., 75 E. Wacker Dr., Chicago
HUNZIKER, O. F., 103 Seventh Ave., LaGrange
HUSSONG, R. V., Kraft Foods Research Labs., 923 Waukegan Rd., Glenview
INGLE, JAMES D., 9825 S. Peoria St., Chicago
JACOBSEN, D. H., Cherry-Burrell Corp., 427 W. Randolph St., Chicago
JENSEN, OTTO G., 112 N. Home Ave., Park Ridge
KANEY, EARL L., 630 Merrill Ave., Rockford
KARNOPP, KARL W., 216 N. Spring St., Waukegan
KEEFFER, KYLE W., 541 Spruce St., Aurora
KEITEL, KLAUS, Millstadt
KELLER, FLOYD M., 309 W. Jackson Blvd., Chicago
KENDALL, K. A., Dairy Husb. Dept., Univ. of Ill., Urbana
KENT, O. B., Quaker Oats Co., Liberty Villa Farm, Libertyville
KLEIN, RALPH A., 1526 S. State St., Chicago
KUEBLER, JUSTA, 706 Maple Ave., Downer's Grove
KUNKEL, REINOLD, Kraft Foods Co., Research Labs., Glenview
LAUTERBACH, A. H., Pure Milk Assoc., 608 S. Dearborn St., Chicago
LONG, HENRY F., Sugar Creek Creamery Co., Danville
*LOOS, HENRY, Kraft Foods Co., Glenview
LOY, WILLIAM C., Wilson & Co., Chicago
MAACK, ARTHUR C., 10905 S. California Ave., Chicago
MAINA, MYRTLE, 3908 N. Springfield Ave., Chicago 18
MARTENS, CARL N., 907 S. Forrest Ave., Carbondale
MARTIN, MRS. ETHEL A., Natl. Dairy Council, 111 N. Canal St., Chicago
MCAULIFFE, HERBERT D., Bowman Dairy, River Forest
*MCKINNEY, WILLIAM B., Beatrice Foods Co., 120 S. LaSalle St., Chicago
NAFIS, LOUIS F., Georgian Hotel, Evanston
NEVENS, W. B., College of Agr., Urbana
NORTH, G. C., Beatrice Creamery, 1526 S. State St., Chicago
ODEKIRK, BURT, Babson Farms, Inc., DeKalb
O'MALLEY, C. M., American Dry Milk Inst., Inc., 221 N. LaSalle St., Chicago
OSRI, STANLEY J., 4100 N. Kenneth Ave., Chicago
OVERMAN, O. R., Dairy Dept., Univ. of Ill., Urbana
PARFITT, E. H., Evaporated Milk Assn., 307 N. Michigan Ave., Chicago
PARKER, MILTON E., Dept. of Food Tech., Ill. Inst. of Tech., 3300 S. Federal St., Chicago
PASHKOW, A. D., 415 W. Scott St., Chicago
PEDRICK, RICHARD F., 429 N. Chicago, Rockford
PETERSON, O. C., 7009 N. Ridge, Chicago
POPE, DONALD B., 703 N. Evans, Bloomington
PROHASKA, J. R., 1529 W. Van Buren St., Chicago
PRUCHA, MARTIN J., 702 Nevada, Urbana
PUTNAM, GEORGE W., 1042 Pontiac Rd., Wilmette
PYENSON, HARRY, Dairy Manufactures Bldg., Univ. of Ill., Urbana

*QUARLES, MARCUS A., 9182 S. Harvard, Chicago 20
RAUSCH, KARL H., 1021 S. Third St., Galena
REEDER, GEORGE W., 5446 S. Dorchester, Chicago
REICHART, E. L., Room 1312, 110 N. Franklin St., Chicago
REINBOLD, GEORGE W. JR., 1005 W. University, Urbana
REMALEY, ROBERT J., 1215 E. 52nd St., Chicago
*RHODE, C. S., Dairy Husb. Dept., Univ. of Ill., Urbana
RICE, FRANK, Evaporated Milk Assoc., 307 N. Michigan Ave., Chicago
RICHARDS, OWEN M., American Dairy Assn., 20 N. Wacker Dr., Chicago
RISHOI, A. H., Cherry-Burrell Corp., 427 W. Randolph St., Chicago
ROBICHAUX, R. P., 4333 N. Winchester, Chicago
ROBINSON, A. A., Shefford Div., Standard Brands, Inc., 327 S. LaSalle St., Chicago
ROUNDY, ZOLA DOYLE, 17 McIntosh Ave., Clarendon Hills
RUEHE, H. A., 908 S. Lincoln Ave., Urbana
SALISBURY, GLENN, Dairy Husb. Dept., Univ. of Ill., Urbana
SAMPSON, JESSE, 509 W. Charles St., Champaign
SCHRENK, O. J., Bowman Dairy Co., 140 W. Ontario St., Chicago
SCHROEDER, HERMAN C., 7938 Crandon Ave., Chicago
SCHUKNECHT, H. E., 308 W. Washington St., Chicago
SCOTT, E. C., Ashton
SEIPP, EDWIN A. JR., Tech. Mgr., Golden State Sales Corp., 221 N. LaSalle St., Chicago
SHADWICK, G. W. JR., Beatrice Creamery Co., 1526 S. State St., Chicago
SHERE, LEWIS, Diversey Corp., 53 W. Jackson Blvd., Chicago
SIEHRS, A. E., Krim-Ko Co., 4830 S. Christiana Ave., Chicago
SIMMONS, NICHOLAS L., 333 N. Michigan Ave., Chicago
SMITH, F. R., Pet Milk Co., Greenville
SMITH, WARREN R., Dairy Dept., Univ. of Ill., Urbana
SNOW, C. H., P.O. Box 77, Bloomington
SNYDER, VICTOR P., 16231 Emerald Ave., Harvey
SOMMER, W. A., Borden's Soy Bean Processing Co., P.O. Box 508, Kankakee
SPANNUTH, H. T., 5458 Dorchester, Chicago
STANLEY, JOSEPH, 139 N. Clark St., Chicago
STEBNITZ, V. C., Chicago Dairy & Food Lab., 6930 N. Clark St., Chicago
STEVENS, SUE CASSELL, 605 W. State St., Jacksonville
STINE, J. BRYAN, Kraft Cheese Corp., 460 E. Illinois St., Chicago
STOKES, LOUIS O., Natl. Pectin Co., 2656 Cullerton St., Chicago
STONE, WARREN K., 912 S. Webber St., Urbana
STORRS, ARNOLD B., Box 13, Palos Heights
STULL, JOHN WARREN, 1108 California, Urbana
TILLEY, W. F., 15725 Marshfield, Harvey
TRACY, PAUL H., Dairy Husb. Dept., Univ. of Ill., Urbana
TUCKEY, S. L., 101 Dairy Manufactures Bldg., Univ. of Ill., Urbana
VANDEMARK, N. L., Dairy Prod. Dept., Univ. of Ill., Urbana
*VORHES, CARL A., O.M.F. & C.I., 1849 Pershing Rd., Chicago
WAKEMAN, ALDEN H., Huntley Rd., Lakewood, Crystal Lake
WEINER, L. H., 1326 Albion Ave., Rogers Pk. Sta., Chicago
WEINREICH, CHARLES F., c/o Cherry Burrell Corp., 427 W. Randolph St., Chicago
WHITNEY, ROBERT McL., Dept. of Food Tech., Univ. of Ill., Urbana
WHITNEY, W. O., 1243 W. Washington Blvd., Chicago
WILSON, H. L., Kraft Cheese Co., 500 Peshtigo Ct., Chicago
WOLFLEY, DONALD V., Hotel Annex, Carrollton
WOODY, CLYDE DALE, Box 37, German Valley
WRIGHT, J. HAROLD, Research Lab., Pet Milk Co., Greenville
YAPP, W. W., 608 W. Green St., Urbana
YENTZEN, V. A., 1415 N. Dearborn Pky., Chicago
YOUNG, PAUL A., 75 E. Wacker Dr., Chicago

Student Affiliates:

ARMSTRONG, J. H., 404B East White, Champaign
BEZIO, CLARENCE A., 2516 W. Farrell Ave., Chicago 45
DUPUY, C. J., 56B Court E., Stadium Terrace, Champaign
EPSTEIN, JEREMIAH F., 408 S. Elm, Champaign
FLAKS, ROBERT E., 404 E. Daniel St., Champaign
HAGG, ROBERT, 820 53rd St., Moline
HANSEN, GEORGE K., 506 N. Edwin, Champaign
HARSHMAN, GENE, 1512 Locust St., Sterling
HAWLEY, BURTON, 1203 2nd Ave., Rock Island
HOWARD, ARTHUR F., 602 S. Third, Dundee
HOYT, DALE, 3125 Barteau Ave., Chicago
JOHNSON, L. R., R.R. 1, Box 406, Batavia
KENT, STANLEY, 58 E. Gregory Dr., Champaign
KIBLER, WILLIAM T., 401 Barr Ave., Jerseyville
KOENIG, RUDOLPH JR., 655 W. Junior Terrace, Chicago
KREBS, LEO G., Poplar Grove
KRUEGER, KENNETH, 817 N. Madison St., Woodstock

LOGUE, BURTON W., 1844 Deerfield Rd., Highland Park
MAGILL, ROBERT, Y.M.C.A., Monmouth
MASSEY, ROY, 1111 S. 1st St., Champaign
MATHESON, MARTIN, 1105 S. Fourth St., Champaign
MILLER, DONALD E., 209 E. Armory, Champaign
OHREN, DELMAR J., 58 E. Gregory Dr., Champaign
OLSON, DONALD R., 1001 W. Illinois, Urbana
RUECKERT, R. P., 505 E. Chalmers, Champaign
SCHNAKE, MELVIN W., Producers Dairy, Springfield
SISLER, WILLIAM, Ohio
SOLDWEDEL, JOHN S., 312 W. Washington, Urbana
SOUTHWELL, LEONARD, 403 2nd St., Pana
THOMPSON, TOM, Box 35, R.F.D., Monee
TOBIAS, JOE, 405½ S. Sixth St., Champaign
TRACY, WILLIAM L., 404 E. Daniel, Champaign
VEDELL, ROBERT, 1231 Third St., Suite 2, Champaign
VOSS, ROBERT, Pectone
VRANA, JAMES JR., 204 E. Harrison St., Sullivan
WESCOTT, GEORGE V., 526 8th St., Wilmette
WESTLAKE, ORVILLE O., 1007 W. Oregon, Urbana
WICKERT, AUGUST L., 1003 W. Cherry St., Marion
WILSON, JOHN D., McNabb

INDIANA

Members:

BABEL, FRED J., Dairy Husb. Dept., Purdue Univ., Lafayette
*BARNETT, BEN F., Silver Lake
BROWN, ROYER H., 1142 N. Meridian St., Room 302, Indianapolis
BRYAN, KENNETH V., Smith Hall, Purdue Univ., Lafayette
CHUMLEA, L. W., Associated Labs., 810 N. Meridian St., Lebanon
*COLE, GLENN H., c/o Swift & Co., Marion
EICHENBERGER, WILLIAM R., 666 Hendricks St., Berne
GALEMA, M. L., R.R. 1, Lafayette
GANNON, E. A., Purdue Univ., Lafayette
GINGERY, ROY, 85½ E. 2nd, Peru
GRAVES, R. R., P.O. Box 392, Valparaiso
GREGORY, H. W., Dairy Husb. Dept., Purdue Univ., Lafayette
HARPER, CLAUDE JR., Tip Top Creamery, Vincennes
HARVEY, JOHN E. JR., 716 E. Woodside St., South Bend
HEDGES, BYRON D., Box 346, Terre Haute
HIGLEY, PHILIP I., 1939 Northwood Dr., Box 693, R.D. 14, Indianapolis
IDDINGS, HARRY G., Rt. 1, Box 185, Gary
JOHNSON, K. R., Smith Hall, Purdue Univ., Lafayette
KING, WILLIS A., Dairy Husb. Dept., Purdue Univ., Lafayette
LACROIX, FRANK E. DE, 1718 Northwestern Ave., Lafayette
LARSON, R. A., Ind. Dairy Prod. Assoc., 623 Bd. Trade Bldg., Indianapolis
LINSCOTT, VERNE, Furnas Ice Cream Co., South Bend
MCPEAK, T. L., 7505 Bradbury Ave., Ft. Wayne
MILLER, NORMAN J., Mead Johnson & Co., Evansville
MOSELEY, W. K., 3862 E. Washington St., Indianapolis
OVERMAN, ORTON, 357 N. Walnut St., Union City
PARSONS, DONALD W., 256 W. 3rd, Peru
PRICKETT, P. S., Mead Johnson & Co., Evansville
RAY, KENNETH W., P.O. Box 153, Newberry
ROBERTS, R. E., 918 Robinson Ave., W. Lafayette
SCHARF, IRVIN C., Purity Maid Prod. Co., New Albany
STARR, GEORGE W., Red 73 Creamery Inc., Union City
STINE, V. L., 110½ E. Pike St., Goshen
STOUT, JOSEPH L., 415 North St., Lafayette
SUHRE, F. H., Columbus
TRIMBLE, J. M., Lebanon
TRUE, N. F., Mead Johnson & Co., Evansville 2
WEISKITTEL, WALTER A., Goshen Milk Cond. Co., Goshen
WEISSERT, C. D., c/o Schlosser Bros. Creamery, Plymouth
*WERLING, WILLIAM H., 861 Lincoln Ave., Evansville 13
WILBUR, J. M., Smith Hall, Purdue Univ., Lafayette
WILLIAMS, G. A., Purdue Univ., W. Lafayette
ZELL, FRED, Rt. 2, Carmel

Student Affiliates:

DRAGGO, EUGENE T., 35 W. Pine St., Knightstown
LEWTON, RONALD K., 1015 N. 7th St., Lafayette
MILLER, ROBERT H., 313 S. Howard St., Summitsville
MOEHLENKAMP, ENCLOE, Pet Milk Co., Angola
PATIL, VASANT M., Dairy Husb. Dept., Purdue Univ., Lafayette
PERISHO, CHARLES, Arcadia
RICH, ROBERT, Asst. County Agent, New Castle

Iowa

Members:

ARNOLD, FLOYD, Ext. Serv., Iowa State College, Ames
BAKER, MERLE P., Dairy Ind. Dept., Iowa State College, Ames
BENNETT, FREDERICK W., Dairy Ind. Dept., Iowa State College, Ames
BIRD, EMERSON W., Dairy Ind. Dept., Iowa State College, Ames
BONEWITZ, PAUL W., Bonewitz Chemicals, Inc., P.O. Box 560, Burlington
BURWELL, F. A., Rath Packing Co., Waterloo
CANNON, C. Y., Animal Husb. Dept., Iowa State College, Ames
CAULFIELD, W. J., Dairy Ind. Dept., Iowa State College, Ames
FAHL, JOSEPH R., 1417 E. Lombard St., Davenport
*FINCHAM, ROBERT C., 222 S. Hazel, Ames
GOSS, E. F., Dairy Ind. Dept., Iowa State College, Ames
HANSON, F. E., 1321 Ave. H., Hawarden
HUGHES, CHARLES E., Successful Farming, Des Moines
IVERSON, C. A., Dairy Ind. Dept., Iowa State College, Ames
JACKSON, LYLE W., c/o Eastern Iowa Artificial Breeding Assn., Cedar Rapids
*JACOBSEN, N. L., Animal Husb. Dept., Iowa State College, Ames
*KRISTOFFERSON, THORVALD, Dairy Ind. Dept., Iowa State College, Ames
LUSH, JAY L., Agr. Hall, Iowa State College, Ames
MORTENSEN, MARTIN, Iowa State College, Ames
MURDOCK, FEMOI R., Borden's Soy Bean Processing Co., Waterloo
NELSON, F. E., Dairy Ind. Dept., Iowa State College, Ames
NIELSEN, VERNER H., Dairy Ind. Dept., Iowa State College, Ames
PARMELEE, C. E., Dairy Ind. Dept., Iowa State College, Ames
PEEBLES, H. E., Bact. Lab., Iowa State Dept. of Agr., Des Moines
PETERS, ISAAC, Dairy Ind. Dept., Iowa State College, Ames
PIRIE, JAMES W., 1108 Glass Rd., Cedar Rapids
PORTER, ARTHUR R., 110 Curtiss Hall, Iowa State College, Ames
*RAPS, GREG, 3108 Ellis, Ames
*RIENKE, EUGENE, 209 Welch, Ames
ROSENBERGER, W. S., 1004 Pammel Ct., Ames
RUDNICK, A. W., 214 S. Russell Ave., Ames
SANDERS, L. R., Hutchinson Ice Cream Co., Cedar Rapids
THOMAS, B. H., 306 Chem Bldg., Iowa State College, Ames
VAN DEVENDER, CLINTON, 107 Howard Ave., Ames
*VOELLKER, DONALD E., 202 Morrill Hall, Iowa State College, Ames
*WARE, ROBERT, Carroll Creamery Co., Carroll
WEAVER, RUSSELL C., 310 S. Tennessee, Mason City
*WEGERMANN, EDWIN H., 864 18th St. S.E., Cedar Rapids
WILKOWSKE, HOWARD, Dairy Ind. Dept., Iowa State College, Ames
WISE, GEORGE H., Dept. of Animal Husb., Iowa State College, Ames

Student Affiliates:

ACKER, ROBERT M., 137 Lynn, Ames
ANDERSON, ROBERT, 854 39th St., Des Moines
ANFINSON, EUGENE A., Huxley
BAKER, R. J., Dairy Ind. Dept., Iowa State College, Ames
BANWELL, ROBERT, 111 N. 17th, Ft. Dodge
BARKER, HAL B., Animal Husb. Dept., Iowa State College, Ames
BEHRENS, ROY, Arlington
BARKER, MELVIN E., Box 13 A, Station A, Ames
BARTLEY, E. E., Animal Husb. Dept., Iowa State College, Ames
BELL, KENNETH E., St. Ansgar
BERNHARDT, JAMES K., 319 Lynn, Ames
CALVERT, PHILLIP, R.F.D. 4, Jefferson
CARROLL, RAYMOND P., Rt. 2 Osage
COE, ROBERT, Route 3, c/o Green Gable Cabins, Ames
COFFIN, DALE, 1067 Pammel Ct., Ames
COLLINS, E. B., Dairy Ind. Dept., Iowa State College, Ames
CUNNINGHAM, CARLYLE, 410 N. Adams, Mason City
DONHOWE, DAVID, Story City
DUDANI, A. T., Dairy Ind. Dept., Iowa State College, Ames
DUMMERMUTH, ROBERT, Elgin
FITCH, CHARLES, 2110 Lincoln Way, Ames
FRITCHEN, D. H., Box 13 A, Station A, Ames
GERRY, KEITH, 17th & Early, Sac City
GERVIS, HUGH B., 2110 Lincoln Way, Ames
GIDEONSEN, RAY, 1933 S. Bluff, Clinton
GILLETTE, RILEY, 304 Welch Ave., Ames
GOODMAN, RICHARD, 2110 Lincoln Way, Ames
GRAHAM, GORDON L., 63 Pammel Ct., Ames
GRAVER, DON, c/o John Hamilton, Wallace Rd., Ames
GRUNHOVD, ADOLPH S., Emmons
HAGEN, VERNON, Joice
HANSEN, CARLYLE, 710 Kellogg, Ames
HASTY, O. V., Gowrie
HENRYSON, ROY, 228 Welch, Ames
HOLMES, WAYNE A., 145 Campus, Ames
HUMMEL, RICHARD, 3114 Brady St., Davenport
HUMPHREY, SAM, 3310 West St., Ames
INGLE, MAX, 4011 Ovid, Des Moines

INGLIS, STANLEY, 518 A Pammel Ct., Ames
JOHANSON, RICHARD E., 304 Welch Ave., Ames
JOHNSON, WARREN H., 1311 A Ave. W., Cedar Rapids
JONES, GAIL M., Barrack 695, Pammel Ct., Ames
KUHL, MARVIN L., 218 Ash, Ames
LARSEN, CYRIL, Box 27, Akron
LEGATES, J. E., 678 Pammel Ct., Ames
LOOS, ERVIN, 221 Sheldon, Ames
MAGRABI, M., Box R, Station A, Ames
MCBRIDE, CLIFFORD, 131 Campus Ave., Ames
MELLEN, LESTER, 424 E. 11th St., Waterloo
MEYERS, WILLIAM, 2816 Wood St., Ames
MODENHAUER, RAYMOND, 83 Pammel Ct., Ames
MONAWECK, JOHN, 2112 Lincoln Way, Ames
MORRISON, HENRY F., 1137 Northwestern, Ames
MORRIS, WALTER, Strawberry Point
MORTIMER, HUGH, Y.M.C.A., Ames
MOTT, CLYDE, 2717 West St., Ames
MURLEY, W. RAY, Dept. Animal Husb., Iowa State College, Ames
NEUROTH, FLORIAN, c/o Mrs. George Schuller, Whittemore
NORRIS, HOOD, 304 Welch Ave., Ames
OLSON, DONALD, 1124 W. 3rd St., Ames
OSAM, DUANE, 1130 N. 19th, Ft. Dodge
PAGE, JOHN M., 304 Welch Ave., Ames
PLATT, THOMAS B., Osborne Cottage, Iowa State College, Ames
SANDERS, ROBERT, Gilbert
SINGH, RAJ NATH, Dairy Ind. Dept., Iowa State College, Ames
SINGLESTAD, CHRISTOPHER, 2717 West St., Ames
STEDMAN, RICHARD E., 361 Pammel Ct., Ames
STRUTHER, GEORGE R., Box 153, Huxley
SUCKOW, DALE C., 301 7th Ave. N.W., Independence
RATHORE, A., Animal Husb. Dept., Iowa State College, Ames
VAN DYKE, DAVID C., 413 Thompson Ave., Waterloo
WAGGONER, BURDETTE, Sutherland
YANG, S. P., Animal Husb. Dept., Iowa State College, Ames
YOUNG, T. E., 3007 Jackson St., Sioux City

KANSAS

Members:

ATKESON, F. W., Dairy Husb. Dept., Kans. State College, Manhattan
BECK, GLENN H., Dairy Husb. Dept., Kans. State College, Manhattan
*BENNETT, BALLARD K., Dairy Dept., Kans. State College, Manhattan
BRIGHT, HOWARD, 5351 Ash St., Mission
*CHILSON, WILLIAM H., Dairy Husb. Dept., Kans. State College, Manhattan
CLAYDON, T. J., Dairy Dept., Kans. State College, Manhattan
DAY, CLARENCE A., 520 Ash St., Ottawa
DUNLAP, J. C., P.O. Box 472, Hutchinson
ECKLES, WILLIAM CLARENCE, 4808 Delmar, Kansas City 3
ELDRIDGE, FRANKLIN, Dairy Husb. Dept., Kans. State College, Manhattan
FOREMAN, CHARLES F., 825 Fremont St., Manhattan
FOUNTAINE, F. C., Dairy Husb. Dept., Kans. State College, Manhattan
GOODBARY, W. ALLAN, County Agent, Iola
*HOSTETLER, P. H., Harper
IBSEN, HEMAN L., Animal Husb. Dept., Kans. State College, Manhattan
LINN, J. W., Ext. Div., Kans. State College, Manhattan
MARTIN, WILLARD H., Kans. State College, Manhattan
PARRISH, DONALD B., Dept. of Chem., Kans. State College, Manhattan
UNDERBJERG, GRAVERS K. L., Dept. of Physiol., Kans. State College, Manhattan
*VOELKER, HOWARD, 806 N. Sunset, Manhattan
*WHITNAH, CARRELL N., Dept. of Chem., Kans. State College, Manhattan

Student Affiliates:

PERRYMAN, RAY, Concordia

KENTUCKY

Members:

BARKMAN, J. O., Dairy Dept., Univ. of Ky., Lexington
BARKMAN, ROBERT L., Prospect
*BLUE, JAMES L. JR., 106 Dairy Bldg., Univ. of Ky., Lexington
*CARPENTER, MARSHALL C., Rt. 6, Louisville
CLIFTON, CARL M., Dairy Dept., 730 Rose St., Lexington
DEUTSCH, ANN, Rt. 4, Box 773, Louisville 13
FITCH, JOHN H., c/o Cardinal Dairies, Cynthiana
FOSTER, JAMES D, 730 Rose St., Lexington
FOSTER, JOHN W., Dairy Dept., Univ. of Ky., Lexington
FREEMAN, THEO. R., Dairy Section, Univ. of Ky., Lexington
HARDESTY, T. C., 1127 W. 2nd St., Owensboro
*HIXSON, E. L., Pet Milk Co., Mayfield
*JOHNSON, JAMES, Rt. 1, Water Valley
*JOHNSON, ROBERT T., 1254 S. Floyd, Louisville
MENNEN, K. E., Armour Creameries, Louisville
MORRISON, H. B., Dairy Dept., Univ. of Ky., Lexington
SEATH, D. M., 106 Dairy Bldg., Univ. of Ky., Lexington
SIMS, ARVY G., c/o J. E. Sims, Mayfield
SUMME, JOHN J., 224 E. 20th St., Covington

Student Affiliates:

ANTLE, GEORGE, 508 Colorado St., Louisville
BUSH, LINNVILLE, 104 George St., Winchester
CONRAD, RUSSELL, Burlington
COWAN, WILLIAM G., Rt. 2, Ewing
CURTSINGER, THOMAS A., P.O. Box 1521, Univ. of Ky., Lexington
DONOHO, HARRY, 215 Waller Ave., Lexington
EVANS, LEE, Butler
FREAS, GEORGE, 450 Rose Lane, Lexington
GARRETT, LANDON, Rt. 2, Waddy
HAYS, ROBERT, 127 Warran Court, Lexington
HUNTER, KYLE, 534 Rose St., Lexington
LINTON, FRANK, 303 E. Maxwell St., Lexington
RARDIN, BURRIS, P.O. Box 1352, Univ. of Ky., Lexington
SAMPLES, RUBERT N., 119 Gazette Ave., Lexington
SMITH, ROBERT S., Rt. 5, Hodgenville
STEMPER, KARL, Rt. 3, Waynesburg
THORNTON, PAUL, P.O. Box 2832, Univ. of Ky., Lexington

LOUISIANA

Members:

*ANDERSON, H. W., Ext. Dairyman, Univ. Sta., Baton Rouge
BRANTON, CECIL, La. State Univ. Artificial Breeding Center, Box 8907, Univ. Sta., Baton Rouge
BROWN, CHARLES A., 841 Exposition Blvd., New Orleans
*BURNS, CLIFTON W., Dept. of Agr., La. Polytechnic Inst., Ruston
CALLOWAY, R. C., Univ. Sta., Baton Rouge
CATHCART, S. L., Iberia Expt. Farm, Jeanerette
DAVIS, C. C., 2618 Calhoun St., New Orleans
FRYE, JENNINGS B. JR., Dairy Dept., La. State Univ., Baton Rouge
GANTT, PAUL E., Rosedale
GELPI, A. J. JR., Dairy Dept., University
MILLER, G. D., La. State Univ., P.O. Box 7443, Baton Rouge
NEASHAM, E. W., La. State Univ., Univ. Sta., Baton Rouge
*PATRICK, THOMAS E., 2130 Stuart Ave., Baton Rouge
RIVERS, PHILIP, Southwestern La. Inst., Lafayette
ROUGEOU, C. L., Dairy Dept., Southwestern La. Inst., Lafayette
RUSOFF, LOUIS L., Dairy Research, La. State Univ., Baton Rouge
RYAN, C. E., P.O. Box 37, Shreveport
*SMYTH, E. R., 4920 Moore Dr., New Orleans
SYNOLD, R. E., c/o J. T. Gibbons, Inc., P.O. Box 284, New Orleans
*WARNER, ROBERT A., 1141 S. Grand St., Monroe

Student Affiliates:

CADWALLADER, J. M. JR., 2874 Reymond Ave., Baton Rouge
CLAYTON, C. J., 632 Univ. Walk, Baton Rouge
JAMES, C. B., 2533 Jessamine Ave., Baton Rouge
NELSON, BILLY, Rt. 4, Ruston
NEWSOM, M. H., Dairy Dept., La. State Univ., Baton Rouge
PERKINS, EDMUND, 652 N. 5th St., Baton Rouge
PESSON, LYNN L., County Agent's Office, St. Francisville

MAINE

Members:

DICKEY, HOWARD, Univ. of Maine, Orono
DORSEY, L. M., Dairy Div., Univ. of Maine, Orono
TRUE, FRANK A., East Corinth

Student Affiliate:

WARD, GERALD M., Rogers Hall, Univ. of Maine, Orono

MARYLAND

Members:

CAIRNS, G. M., Dairy Dept., Univ. of Md., College Park
CARY, C. A., 4605 Queensbury Rd., Riverdale
CASKEY, C. D. JR., Southern States Coop., 2101 E. Fort Ave., Baltimore 30
CONVERSE, H. T., Beltsville
*ELLMORE, FRANKLIN, Dairy Husb. Dept., Univ. of Md., College Park
ELY, RAY E., Bureau of Dairy Ind., Beltsville
ENGLAND, C. W., 4408 Underwood St., Hyattsville
GIFFORD, JOHN, P.O. Box 389, Silver Spring
GOULD, I. A., Dairy Dept., Univ. of Md., College Park
HANSEN, P. ARNE, Dept. Bact., Univ. of Md., College Park
HARDING, H. G., Natl. Dairy Prod. Research Labs., 1403 Eutaw Place, Baltimore
*HETZIOLOS, B. C., Animal Husb. Dept., Univ. of Md., College Park
HILLER, ROBERT A., Bureau of Dairy Ind., Beltsville
HODGSON, R. E., 7006 Wake Forest Dr., College Park
*JACOBSEN, W. C., Bureau of Dairy Ind., Beltsville

JOHNSON, BRUCE C., Dairy Husb. Dept., Univ. of Md., College Park
LESCURE, J. M., Fairfield Western Md. Dairy, Linden Ave., Baltimore
MARTY, IVAN H., Rm. 902, Municipal Bldg., Baltimore
MATTHEWS, CHARLES A., Bureau of Dairy Industry, Beltsville
McDONALD, CHARLES S., 1762 Overlook Dr., Silver Spring
McELWEE, H. W., 201 Reynolds Ave., Hagerstown
MECHAM, C. MARION, 2503 Taylor Ave., Baltimore
METCALF, KENNETH L., Box 459, Frederick
MOORE, L. A., Bureau of Dairy Ind., Beltsville
*POU, JOHN W., Dairy Dept., Univ. of Md., College Park
ROBERTS, HENRY E., Mt. Aarat Farms, Port Deposit
*SAARINEN, PELLERVO, Animal Husb. Dept., Univ. of Md., College Park
*SAMI, MUHAMMAD, Animal Husb. Dept., Univ. of Md., College Park
*SCHABINGER, J. R., Asst. County Agent, Westminster
SENGER, MARVIN E., Dairy Dept., Univ. of Md., College Park
SHAW, JOSEPH C., Univ. of Md., College Park
SHEPHERD, J. B., 9528 49th Ave., Berwyn
SIEGEL, MAURICE, 15 S. Gay St., Baltimore
SIEGMUND, H. B., Hendler Creamery Co., 1100 E. Baltimore St., Baltimore
STOUT, ROBERT E., 4206 53rd Ave., Apt. A, Bladensburg
SYKES, JOSEPH F., Bureau of Dairy Ind., Beltsville
THOMAS, J. WM., Bureau of Dairy Ind., Beltsville
TREBLER, H. A., 14 E. Chase St., Baltimore
WEATHERBY, EDWIN J., 8501 Greenwood Ave., Takoma Park

Student Affiliates:

ECKELS, AUGUST ERNEST, 1709 E. 31st St., Baltimore
HAZLEWOOD, FRED, 5504 Fairglen Rd., Chevy Chase
SHUTRUMPF, ROBERT J., Ve 10-B, College Park

MASSACHUSETTS

Members:

ABRAHAMSON, CARL E., 45 Queen St., Franklin
ARCHIBALD, JOHN G., Animal Husb. Dept., Univ. of Mass., Amherst
BIRDSEYE, CLARENCE, Eastern Point Blvd., Gloucester
BOARDMAN, WILLIAM, 175 Montgomery Rd., Westfield
BURKE, EDMUND W., Lyndonville Creamery, 86 Elm St., Watertown
CAMPBELL, P. A., Eastern States Farmers Exchange, W. Springfield
CORT, JOSEPH C., 41 Fremont St., Boston
DANGEL, PHOENIX N., Kendall Mills, Walpole
FAY, A. C., H. P. Hood & Sons, 500 Rutherford Ave., Boston
*FINNEGAN, E. J., Dairy Dept. Univ. of Mass., Amherst
FOLEY, RICHARD C., Stockbridge Hall, Univ. of Mass., Amherst
FRANDSEN, J. H., Univ. of Mass., Amherst
FREEMAN, STANLEY L., 419 Spring St., W. Bridgewater
*GAREY, CORY C., Flying Horse Farm, South Hamilton
GAUNT, STANLEY N., Stockbridge Hall, Univ. of Mass., Amherst
*GUIMOND, ARTHUR C., 359 Robeson St., Fall River
*HANKINSON, D. J., Dairy Ind. Dept., Univ. of Mass., Amherst
*HAWKINS, V. M. JR., 53 Pleasant St., Sharon
HOLMES, ARTHUR D., Univ. of Mass., Amherst
HOWARD, HARLAN A., 750 N. Pleasant St., Amherst
*KEITH, ROBERT H., 153 Malden St., Worcester
KENDALL, C. DONALD, 29 Craiwell Ave., Springfield
*LARKIN, E. P., Dairy Dept., Univ. of Mass., Amherst
LINDQUIST, HARRY G., Dairy Ind. Dept., Mass. State College, Amherst
LYTHGOE, HERMANN C., 36 Fair Oaks Ave., Newtonville 60
MARCUS, THEODORE, 577 Blue Hill Ave., Roxbury
MUELLER, W. S., Dairy Ind. Dept., Univ. of Mass., Amherst
NELSON, D. H., Dairy Ind. Dept., Univ. of Mass., Amherst
*REED, FRANK H., 53 Federal St., Wayside Farm Creamery, Greenfield
*RENOUF, HENRY, Robin Farm, Belchertown
RICE, V. A., Univ. of Mass., Amherst
*ROSE, JOHN P., 11 North St., Haverhill
SELBY, H. W., United Farmers Corp., Charlestown
SHRADER, J. H., Eastern Nazarene College, Wollaston
SIBLEY, JOHN R., Spencer
SMITH, ALBERT W., United Dairy System, Springfield
SMITH, CHESTER G., Box 141, Hadley
*STEVENS, KENNETH M., 121 Randolph St., N. Abington
*STITTS, T. G., H. P. Hood & Sons, 500 Rutherford Ave., Boston
*TOOLEY, HARRY C., Health Dept., Pittsfield
WALTS, C. C., H. P. Hood & Sons, Research Dept., 56 Roland St., Boston
WARD, RUEL E., Eastern States Farmers Exchange, Springfield

WATSON, JAMES G., New England Homestead, Springfield
WHITWORTH, JOHN, 40 Garland St., Melrose
*WILDE, H. G., Highlawn Farm, Lenox
WILLMANN, ALFRED, 165 Clifton St., Belmont
WISE, ROBERT, Natl. Ice Cream Co., 166 London St., E. Boston

Student Affiliates:

BLANCHARD, PHILIP J. JR., 50 Hollywood St., Worcester
BLISS, THOMAS K. JR., 697 Park St., Attleboro
BOYLE, RICHARD S., 30 Maple Terrace, W. Springfield
CAMPBELL, RAYMOND W. J., 45 Carruth St., Dorchester
CASH, CLARENCE D., 39 Conway St., Greenfield
CRANE, FRANCIS R., 111 Cottage St., Leominster
DEYOUNG, RAYMOND C., 31 Bayview St., North Weymouth
FULLER, ROBERT, 3 Sheldon St., Haverhill
GANTMAN, MILTON, Box 41, Essex Sta., Boston
GOKCE, KEMAL, 95 E. Pleasant St., Amherst
GRIFFIN, PATRICK, 97 Grove St., Winchester
JOHNSON, ALBERT R., R.F.D. 1, Lowell
KRONICK, DAVID, 65 Chestnut St., N. Adams
LAIPSON, MYRON R., 14 Hudson St., Worcester
LEBEAU, KENNETH D., 67 Lowell Rd., Wellesley Hills
MCMANUS, MARTIN S., 22 Louise St., Worcester
MERRILL, WILLIAM R., 47 Florence Ave., Norwood
NICHOLS, GILBERT W., 22 Cross St., Westboro
UTLEY, SAMUEL T., Hinsdale
YALOFF, ABRAHAM S., 206 Chadbourne Hall, Univ. of Mass., Amherst

MEXICO

Members:

CAMPOS-LYNCH, PAUL, Niza 15, Mexico City
CARRANCEDO, EDUARDO GARCIA, Calle Alamo 40, Mexico D.F.
HALLATT, H. M., Cremeria Kiko S. A Ave., Alvaro Obregon 52, Mexico D.F.
MCALLISTER, WALTER E., Lecheria Nacional S. A., Mexico D. F.

MICHIGAN

Members:

ALGER, HARRY B., 13505 Griggs, Detroit
BAILEY, HERBERT, The Whittin, Burns Drive, Detroit
BALTZER, A. C., Dairy Dept., Mich. State College, East Lansing
BECHTEL, H. E., Box 68, North End Sta., Detroit
BORTREE, A. L., Bact. Dept., Mich. State College, East Lansing
BRUNNER, ROBERT, Dairy Dept., Mich. State College, East Lansing
BRYAN, C. S., Medicine Dept., Mich. State College, East Lansing
BRYANT, C. B. A., Box 455, Montgomery
BURLINGAME, M. M., Borden's Farm Prod. Co., 3600 Forest Ave. E., Detroit
CHRISTIANSEN, JAMES, Box 68, North End Sta., Larro Research Farm, Detroit
COLE, CLARENCE L., 4151 McKay Rd., Romeo
COPE, GEORGE, 2111 Riverside Dr. N. W., Grand Rapids
COURTIS, JOSEPH W., P.O. Box 480, Ann Arbor
DEW, PAUL R., 114 Buffalo St., Bad Axe
DUNCAN, CLIFFORD W., Agr. Chem. Dept., Mich. State College, East Lansing
DUNN, J. A., Diamond Crystal Salt Co., St. Clair
*DUNN, KENNETH M., Dairy Dept., Mich. State College, East Lansing
EWBANK, F. C., Mich. Milk Prod. Assn., Imlay City
FABIAN, F. W., Div. of Vet. Science, Mich. State College, East Lansing
FARRALL, A. W., Head Dept. Agr. Engr., Mich. State College, East Lansing
GIRRBACH, GEORGE, Soo Creamery, Sault Ste. Marie
HORWOOD, RUSSELL E., Dairy Husb. Dept., Mich. State College, East Lansing
HUFFMAN, CARL F., Dairy Dept., Mich. State College, East Lansing
JENSEN, J. M., Dairy Dept., Mich. State College, East Lansing
JOHNSON, LAWRENCE A., Dairy Dept., Mich. State College, East Lansing
JONES, V. R., Wyandotte Chem. Corp., Wyandotte
LEWIS, ROBERT C., Dairy Dept., Mich. State College, East Lansing
LUCAS, P. S., 909 Sunset Lane, East Lansing
LUTZ, WILLIAM B., Upper Peninsula Expt. Sta., Chatham
MCMAHON, HARRY, 8047 Hamilton Ave., Detroit
MCMILLAN, DONALD Y., 301 Second St. E., Flint
MINOR, L. H., 3138 Birchwood, Trenton
MITTEN, HORACE L., 349 University Dr., East Lansing
MORLEY, LEWIS W., Mich. Milk Prod. Assoc., 406 Stephenson Bldg., Detroit
MURRAY, D. L., Dairy Husb. Dept., Mich. State College, East Lansing
*NELSON, RONALD H., Animal Husb. Dept., Mich. State College, East Lansing

NOBLITT, C. O., Box 55, College Sta., Berrien Springs
PARSONS, GEORGE E., Dairy Bldg., Mich. State College, East Lansing
PETRIE, E. R., Lockshore Farm, Hickory Corners
REINEKE, E. P., Dept. of Physiol., Mich. State College, East Lansing
RICHARDS, W. F., c/o Blanding Dairy, 205 Brush St., St. Johns
ROEHM, L. S., Tech. Serv., Dow Chem. Co., Midland
ROGERS, C. A., 8731 Witt St., Detroit
SALSBURY, R. L., 211 S. Sycamore, Lansing
SARKAR, B. C. RAY, Agr. Expt. Sta., Agr. Chem. Dept., East Lansing
SEIDEL, C. J., 1838 McKinley Ave., Bay City
SEIDEL, MARTIN, 403 E. John St., Bay City
SMITH, WAYNE E., 701 Michigan Ave., Sturgis
SNYDER, WOODROW, Dairy Husb. Dept., Mich. State College, East Lansing
STEPHENSON, ROBERT, 994 61st St. S.E., Grand Rapids
STRAIT, HOWARD, 516 Center St., Sturgis
TROUT, G. MALCOLM, Dairy Dept., Mich. State College, East Lansing
WEAVER, EARL, Dairy Dept., Mich. State College, East Lansing
WEBER, DALE K., Box 2007, Mich. Ave. Sta., Lansing

Student Affiliates:

ANDERSON, THOMAS H., Dairy Dept., Mich. State College, East Lansing
DANCER, ROBERT, Dairy Dept., Mich. State College, East Lansing
DANDO, ROBERT, P.O. Box 161, East Lansing
DELAYA, H. M., Dairy Dept., Mich. State College, East Lansing
FLIPSE, ROBERT, Dairy Dept., Mich. State College, East Lansing
FREEMAN, GEORGE A., Dairy Dept., Mich. State College, East Lansing
HANNON, RICHARD D., Dairy Dept., Mich. State College, East Lansing
HUBBLE, MAURICE, Dairy Dept., Mich. State College, East Lansing
LAMMY, JACK, Dairy Dept., Mich. State College, East Lansing
LIED, MARVIN, 807 Minnesota Ave., Gladstone
MARSHALL, MILTON, Dairy Dept., Mich. State College, East Lansing
MEISER, JOSEPH JR., Dairy Dept., Mich. State College, East Lansing
WARD, GEORGE M., Dairy Dept., Mich. State College, East Lansing
WATERSON, JOE T., 1737 Webster, Birmingham
WEAVER, HAROLD, Dairy Dept., Mich. State College, East Lansing
WEINSTEIN, BERNARD, Dairy Dept., Mich. State College, East Lansing

MINNESOTA

Members:

ASTROTH, FRANK B., 1453 Hythe St., St. Paul
BARKER, E. M., Rochester Dairy Co., Rochester
BARNES, JOHN C., 302 E. Alcott Ave., Fergus Falls
*BERG, INGVALD A., 240 24th Ave., S., Minneapolis
BONNEY, RICHARD, 507 S. Cleveland Ave., St. Paul
BOSWORTH, GROVER, 3125 Nicolett, Minneapolis
CLARK, DONALD M., Twin City Milk Prod. Assoc., 1001 Glenwood Ave. N., Minneapolis
COMBS, W. B., Dairy Div., Univ. Farm, St. Paul
CONNER, J. K., Lakeville Creamery Co., Lakeville
COULTER, S. T., Univ. Farm, St. Paul
*DEWEY, LLOYD G., Dairy Husb. Div., Univ. of Minn., St. Paul
FARRAR, ROBERT R., Rt. 8, St. Paul
FITCH, J. B., Dairy Husb. Dept., Univ. Farm, St. Paul
FOURNELLE, H. J., 106 N. Smith Ave., Apt. 340, St. Paul
FREDERIKSEN, F. M., 222 Third St., N.E., Faribault
GEIGER, ROBERT, 2274 W. Como Ave., St. Paul
GILMORE, JOHN, Land O'Lakes Farm, R.D. 3, Anoka
GULLICKSON, T. W., Univ. Farm, St. Paul
HALVERSON, RALPH, Mora
HANKINSON, CLOYCE L., North American Creameries, Inc., Paynesville
HANSON, CLEMENTS C., Barnum Creamery Co., Barnum
HANSON, RAYMOND L., 815 7th Ave. S.W., Rochester
HARLAND, HERBERT A., Div. of Dairy Husb., Univ. of Minn., St. Paul
HAWKINS, ORVILLE J., 2274 Como Ave., St. Paul
HEALY, HENRY A., Dairy Prod. Labs., 2244 Carter Ave., St. Paul
HEDRICK, T. I., North Star Lab., 169 E. 6th Ave., St. Paul
JENNESS, ROBERT, Div. of Agr. Biochem., Univ. of Minn., St. Paul
JEZESKI, JAMES J., Dairy Husb. Dept., Univ. of Minn., St. Paul
JOHNSON, O. C., 515 State Office Bldg., Dairy & Food Dept., St. Paul
KETCHAM, WESLEY J., 1125-9½ Ave. S.E., Rochester
*KOHLER, HENRY, 411 Banning Ave., White Bear Lake
LARSON, GILBERT O., 1407 Randolph St., St. Paul
LEIGHTON, RAMER, Univ. Farm, St. Paul
*LYON, HOMER, Bridgeman-Russell Co., Duluth

MACY, HAROLD, Div. of Dairy Husb., Univ. Farm, St. Paul
MATTSON, H. A., Box 145, Minneapolis
MILLER, KENNETH P., Univ. of Minn., Grand Rapids
MILLER, WALLACE, New Prague
*MODEN, GILMER, 305 Sheridan St., Albert Lea
NELSON, H. GODFREY, Div. of Pub. Health, 401 City Hall, Minneapolis
NELSON, J. WESLEY, 200 Grain Exchange Bldg., Minneapolis
*NUPSON, H. N., Redwood Falls
OLSON, FLOYD C., 435 S. Broadway, Stillwater
OLSON, JOSEPH C. JR., Dept. of Dairy Bact., Univ. Farm, St. Paul
PETERSEN, W. E., Dairy Dept., Univ. Farm, St. Paul
*PFEIFER, GEORGE B., 4800 Emerson Ave. S., Minneapolis
SCARR, DAVID N., West Concord
SEARLES, H. R., Agr. Ext. Div., Univ. of Minn., St. Paul
SEATH, R. W., 104 E. University St., Owatonna
*SIPIORA, JULIAN E., Kraft Foods Co., 100 N. 7th St., Minneapolis
SORENSEN, C. M., 752 Vandalia St., St. Paul
SORENSEN, FRANKLIN L., 1967 Grand Ave., Apt. 203, St. Paul
*THOELE, HOWARD W., 1309 E. 4th St., St. Paul
THOMAS, ELMER, Div. of Dairy Husb., Univ. Farm, St. Paul
THOMPSON, THROND, 5421 Queen Ave. S., Minneapolis
TJOSVOLD, DALE, 801 E. Shakopee Rd., Minneapolis
TRYGGESETH, O. A., 4239 31st Ave. S., Minneapolis
VACHA, G. A., Room 527, State Office Bldg., St. Paul
WAGENAAR, RAPHAEL, Div. of Dairy Husb., Univ. Farm, St. Paul
WAYNE, RALPH W., 2160 Carter Ave., St. Paul
WEIMAR, A. C., 5325 Grand Ave. S., Minneapolis
WELLS, CLAUDE B. JR., 618 3rd St. S.W., Rochester
WILSON, JOHN L., Economics Lab., Inc., 914 Guardian Bldg., St. Paul
ZAKARIASEN, BEN M., 1369 Cleveland Ave. N., St. Paul

Student Affiliates:

EBEL, URBAN H., Moose Lake
GROVE, DARYL, 1810 E. 10th St., Duluth
HILL, DONALD L., Div. of Dairy Husb., Univ. Farm, St. Paul
JARL, LEROY E., 1222 Sixth St. S.E., Minneapolis
KARNS, DONALD, 1017 London Rd., Duluth
LI, LAWRENCE, Div. of Dairy Husb., Univ. Farm, St. Paul
MATHISON, JOHN H., 2154 Commonwealth Ave., St. Paul
MCCORMICK, PATRICK, 2150 Berkeley St., St. Paul
MIX, LEW S., Div. of Dairy Husb., Univ. of Minn., St. Paul
MORRIS, HOWARD A., Div. of Dairy Husb., Univ. of Minn., St. Paul
NELSON, HARVARD G., Div. of Dairy Husb., Univ. Farm, St. Paul
NICKERSON, THOMAS A., 2417 Pleasant Ave., Minneapolis
NUPSON, HENRY, Redwood Falls
REGER, JOSEPH V., 921 W. Hoyt, St. Paul
REINARZ, RUSSELL R., 3138 Cedar Ave. S., Minneapolis

MISSISSIPPI

Members:

ANDERSON, ARLIS, State College
*BROOKSHIRE, N. D., Brookshire Ice Cream Co., Meridian
COWSERT, W. C., Box 452, State College
*DAVIS, LUKE, Kraft Foods Co., Box 549, Columbus
*DOWNIE, R. L., West Point
FLETCHER, LANE, Animal Husb. Dept., Miss. State College, State College
HERZER, F. H., Dept. of Dairying, Miss. State College, State College
HIGGINS, L. A., Starkville
HONER, CLEM, Dairy Dept., State College
MITCHELL, S. B., Houston
PEARSON, JOHN A., 224 W. North St., Kosciusko
*WARD, R. A., McCleran Ice Cream Co., Tupelo
WATERS, RICHARD E., Starkville

Student Affiliates:

BETTERTON, CHARLES M., Box 145, Starkville
CASTLES, JOHN, Rt. 1, Starkville
COX, GEORGE JR., P.O. Box 423, Brookhaven
DALEY, CHARLES B., Box 302, State College
DAVIS, MARVIN E., Box 1199, State College
KNOWLES, CALVIN I., Rt. 2, Blue Springs
MEADOWS, LUTHER O., Box 27, State College
MORRIS, BYRON, Box 995, State College
SPARKS, VERNON D., Box 281, State College
STEWART, BEN R., Box 1133, State College
TEMPLETON, LESLIE O., Rt. 3, Tupelo
WILLIAMS, DAVID D., Rt. 2, Starkville

MISSOURI

Members:

BRODY, SAMUEL, Dairy Dept., Univ. of Mo., Columbia
BROX, JOHN P., 1514 Windsor, Columbia
CASSIDY, B. J., 3110 Gillham Rd., Kansas City
CLONINGER, WILLIAM H., Ext. Dairying, Eckles Hall, Columbia
DAVIS, GLENN G., Rt. 6, Columbia
DEW, GEORGE, 3915 Paseo Blvd., Kansas City
DICKERSON, G. E., Animal Husb. Dept., Univ. of Mo., Columbia
EDMONDSON, JOE E., 224 Eckles Hall, Univ. of Mo., Columbia
EDWARDS, FRED, Producers Creamery Co., Cabool
FENNER, GEORGE H., Western Dairy & Ice Cream Co., 218 S. 5th St., St. Joseph
FERRAEZ, NICOLAS JR., 5800 Pershing Ave., St. Louis
GEORGE, B. J., c/o Kansas City Power & Light Co., 1330 Baltimore Ave., Kansas City
GHOLSON, JAMES H., 103 Eckles Hall, Univ. of Mo., Columbia
GRAHAM, W. R. JR., Cerophyl Lab., Inc., P.O. Box 356, Kansas City
HARRIS, RANSOM C., Beatrice Creamery Co., Main & Jules Sts., St. Joseph
HEINEMANN, BURDET, c/o Producers Creamery Co., 555 W. Phelps St., Springfield
HENRY, VANCE, 817 College Ave., Columbia
HERMAN, HARRY A., Dairy Husb. Dept., College of Agr., Columbia
HUNT, EDW. S., 4933 Tracy, Kansas City
HUNT, LESLIE L., Pet Milk Co., 1401 Arcade Bldg., St. Louis
ITSCHNER, E. T., Eckles Hall, Univ. of Mo., Columbia
*JOHNSTON, HARVEY L., Rt. 1, Golden City
KIBLER, H. H., Dairy Dept., 208 Eckles Hall, Univ. of Mo., Columbia
KNUDSEN, EDWIN, 814 E. 8th St., Trenton
KOCHER, DANIEL S., Aines Farm Dairy Co., 31st & Gillam Rd., Kansas City
LATZER, ROBERT L., 1401 Arcade Bldg., St. Louis
LEACH, CARL A., Miller Bldg., 8th & Broadway, Columbia
LIDE, B. M. JR., 2001 Chestnut St., St. Louis
MORGAN, ROY, Country Club Dairy Co., 5633 Troost Ave., Kansas City
PLATTENBURG, H. H., Home Dairy, Box 34, Kansas City
POWELL, E. B., Research Farm, Ralston Purina Co., 835 S. 8th St., St. Louis
QUIGLEY, J. V., Chapman Dairy Prod., 1217 Harrison St., Kansas City
RAGSDALE, A. C., Eckles Hall, Univ. of Mo., Columbia
RASKAS, RALPH, 7148 Pershing Ave., University City
REGAN, M. J., Dairy Dept., Univ. of Mo., Columbia
REID, WILLIAM H. E., Dept. of Dairy Husb., Univ. of Mo., Columbia
STALLCUP, ODIE TALMADGE, 225 Eckles Hall, Columbia
STEPHENS, A. F., 4929 McPherson, St. Louis
THOMPSON, J. C., Ralston Purina Co., 835 S. 8th St., St. Louis
TURNER, CHARLES W., Dairy Husb. Dept., Univ. of Mo., Columbia
VARNEY, BRUCE, 328 Bd. of Trade Bldg., 127 W. 10th St., Kansas City
WEAR, JOHN M. JR., Purina Research Farm, Gray Summit
*WALKER, J. C., Walker Farms, Stoneville
WOLFF, STEPHEN J., Peveley Dairy Co., 1001 S. Grand Blvd., St. Louis

Student Affiliates:

CARSON, J. H., 208 N. Virginia, Charleston
COBBLE, JAMES W., 127 Eckles Hall, Columbia
COSTELLO, M. J., 704 S. Florence, Springfield
EDMONDSON, JUSTUS H., 127 Eckles Hall, Columbia
FISHER, R. C., R.F.D. 2, Wright City
FRANKE, GLENN O., Box 42, Maryland Heights
GADD, ERWIN, Rt. 4, Lebanon
HARTLEY, J. L., 505 Hitt St., Columbia
KAMAL, SYED, Dairy Husb. Dept., Univ. of Mo., Columbia
KAUFFMAN, EUGENE, 307 College Ave., Columbia
KUMARAN, J. D. S., 218 Eckles Hall, Columbia
LABEN, ROBERT, 127 Eckles Hall, Columbia
MARTIN, DAVID A., Rt. 1, Box 416, Springfield
MERILAN, CHARLES P., 103 Eckles Hall, Columbia
MONROE, ROBERT A., 217 Eckles Hall, Columbia
PEREGOY, RODERICK D., Rt. 2, Henderson
PFANDER, HOMER, Rt. 1, Liberal
PIPES, GAYLE W., 217 Eckles Hall, Columbia
PURSELY, GLEN R., 802 Virginia Ave., Columbia
ROARK, DONALD B., 15 Observatory Hill, Columbia
SANDERS, DOYLE S., Willow Springs
SANDRIDGE, R. E., 501 Conley, Columbia
SHAFFER, LOREN O., 201 Eckles Hall, Columbia
TALLMAN, KENNETH L., 223 Eckles Hall, Columbia
THOMAS, ROBERT H., 823 Rollins St., Columbia
WALL, CHESTER, 1516 Ross St., Columbia
WARREN, ANDREW P., 1318 Anthony, Columbia

MONTANA

Members:

BRATTON, EDW., Ronan
BRENCE, JOHN L., Dairy Ind. Dept., Mont. State College, Bozeman
GOBLE, HAROLD, Jersey Dairy, Bozeman
HARRISBERGER, WARREN, P.O. Box 1381, Great Falls
KEYES, EVERETT A., Dairy Ind. Dept., Mont. State College, Bozeman
KOPLAND, D. V., Huntley Field Sta., Huntley
MACIVER, KENNETH S., 402 W. Cleveland, Bozeman
MITCHELL, FERGUS G., Ayrshire Dairy, Great Falls
NELSON, J. A., Dairy Ind. Dept., Mont. State College, Bozeman
ROSENEAU, FRED, 425 1st Ave., S.W., Great Falls
SLACK, RANSOM O., Gold Medal Dairies, Missoula
TRETSVEN, J. O., Dairy Specialist, Mont. State College, Bozeman

Student Affiliates:

HALES, RALPH E., Dept. of Dairy Ind., Mont. State College, Bozeman
HUANG, W. Y., Dairy Ind. Dept., Mont. State College, Bozeman
MCMURRAY, JOHN A., 401 S. 5th Ave., Bozeman
PEACE, EARL J., Dairy Ind. Dept., Mont. State College, Bozeman
REHBERT, WALLACE A., Dairy Ind. Dept., Mont. State College, Bozeman
TURNER, CHARLES G., Dairy Ind. Dept., Mont. State College, Bozeman

NEBRASKA

Members:

CROWE, L. K., Dairy Husb. Dept., Univ. of Nebr., Lincoln
DAVIS, H. P., Dairy Dept., College of Agr., Lincoln
DAY, R. E., Allied Mills, Inc., Omaha
*DEANE, DARRELL D., Dept. of Dairy Husb., Univ. of Nebr., Lincoln
DOWNS, P. A., Dept. of Dairy Husb., Univ. of Nebr., Lincoln
FARR, R. H., 5636 Oak St., Omaha
FOSSLAND, ROBERT G., Dairy Husb. Dept., Univ. of Nebr., Lincoln
GERRISH, F. S., 609 Redick Tower, Omaha
HATHAWAY, IRWIN L., Dept. of Dairy Husb., Univ. of Nebr., Lincoln
HOWE, D. K., Fairmont Foods Co., Omaha
NIBLER, C. W., Dairy Bldg., College of Agr., Lincoln
PETERSON, HERLUF, 246 4th St., Albion
RUMERY, MYRON G. A., Expt. Sta., North Platte
SANDERS, CHRIS H., Dairy Dept., Univ. of Nebr., Lincoln
SCHULTZE, ANDREW B., Dairy Husb. Dept., Univ. of Nebr., Lincoln
TEMPLETON, HUGH L., 6125 Florence Blvd., Omaha

Student Affiliates:

BAKER, FOREST, 1221 N. 37th St., Lincoln
BECKMAN, DALE R., 1937 F, Apt. G1, Lincoln
CALHOUN, JEROLD W., Rt. 1, North Platte
CLAYBAUGH, GLENN, 2421 N. 63rd, Lincoln
CERNY, JOHN H., Dorchester
CHRISTENSEN, DON E., 3455 Orchard, Lincoln
KEENEY, PHILIP C., 3605 Holdrege, Lincoln
HUSA, MELVIN M., Crete
JENSEN, EUGENE, 4013 Holdrege, Lincoln
MICKLE, JIM, 5302 Walker Ave., Lincoln
MORGAN, CHRISTOPHER, 5103 Greenwood, Lincoln
NELSON, LEROY F., Rt. 1, Bertrand
RADENBAUGH, GEORGE, 224 Huskerville, Lincoln
SINGH, CHANDRA BHAN, Dairy Husb. Dept., Univ. of Nebr., Lincoln
STEFFEN, RICHARD R., Diller

NEVADA

Members:

HEADLEY, F. B., Dept. of Farm Div., Univ. of Nev., Reno

NEW HAMPSHIRE

Members:

AMIDON, WINTHROP R., c/o H.H.B.A., Rt. 4, Concord
BOYNTON, HILTON, Ext. Dairyman, Univ. of N. H., Durham
CUMMINGS, C. M., American Guernsey Cattle Club, Peterborough
ELDER, THOMAS E., Alton
FARRAR, PRESCOTT S., Div. Food & Chem., State Dept. of Health, Concord
KEENER, HARRY A., Dairy Husb. Dept., Univ. of N. H., Durham
MOORE, H. C., Dairy Dept., Univ. of N. H., Durham
MORROW, K. S., Dairy Husb. Dept., Univ. of N. H., Durham

OLSSON, G. B., Dairy Dept., Univ. of N. H., Durham
PIKE, ADNA B., Dept. of Agr., Concord
SHULTZ, EARL N., American Guernsey Cattle Club, Peterborough

NEW JERSEY

Members:

BARTLETT, J. W., Dairy Dept., N. J. Agr. College, New Brunswick
BAUERNFEIND, J. C., Hoffman-La Roche Inc., Nutley
BECKER, HENRY, Livingston Ave., Roseland
BENDER, CARL B., Dairy Husb. Dept., N. J. Agr. Expt. Sta., New Brunswick
BERGGREN, RUTH E. L., Kind & Knox Gelatine Co., Head of N. 5th St., Camden
BERLINER, VICTOR R., Ortho Pharm. Corp., Raritan
BISHOP, JOHN V., Columbus
BOROWSKY, HARRY H., Onyx Oil & Chem. Co., Warren & Morris Sts., Jersey City
BRYAN, JOHN S., c/o Walker-Gordon Lab. Co., Plainsboro
CLARK, ROBERT I., Apt. 2B-3OA, Meadowbrook Village, Plainfield
CONN, RALPH I., 4 Carpenter Terrace, Belleville
*DOUGHTY, RICHARD S., 34 Hillside Ave., Chatham
FRANCISCO, CARL, c/o Middlebrook Farm, Route 1, Asbury Park
GREEN, D. F., 125 Thomas St., Cranford
HERROLD, JOHN, Library, Natl. Oil Prod. Co., Harrison
JOHNSTON, JAMES E., Dairy Research Farm, Sussex
KEENEY, MARK H., Cedar Grove
LEAR, SAMUEL A., Dairy Husb. Dept., Rutgers Univ., New Brunswick
LEEDER, JOSEPH, Dairy Ind. Dept., Rutgers Univ., New Brunswick
LEVOWITZ, DAVID, N. J. Dairy Labs., 226 Eastern Ave., New Brunswick
LITTLE, LAWRENCE, E. F. Drew & Co., Inc., 416 Division St., Boonton
MATHER, R. E., Dairy Research Sta., Sussex
MCCAN, J. C., 246 Grant Ave., Highland Park
MIXNER, JOHN P., Dairy Research Sta., Sussex
*MOSS, J. R., 709 Mountain Ave., Westfield
NAIR, JOHN H., Continental Foods, Inc., Hoboken
PERRY, E. J., N. J. Agr. College, New Brunswick
PFAU, KARL O., Dairy Research Sta., Sussex
REECE, RALPH R., Dairy Husb. Dept., N. J. Agr. Expt. Sta., New Brunswick
SCHEIDENHELM, E. C., Dairy Dept., Rutgers University, New Brunswick
SHUART, C. EDMUND, N. J. Expt. Sta., Sussex
STONE, EDWARD JAMES, Dairy Research Sta., Sussex
*TAYLOR, JOHN E., Breyer Ice Cream Co., 444 Raymond Blvd., Newark
TITUS, HARRY W., Lime Crest Research Lab., R.D. 1, Newton
TREGURTHA, JAMES D., Newark Milk & Cream Co., 26 Bridge St., Newark
VAHLTEICH, H. W., c/o Best Foods Inc., Bayonne
WALDRON, MARC C., Califon
WELSH, MARK, 239 Beechwood Rd., Ridgewood
WIGGIN, STANLEY H., R.F.D. 2, Newton

Student Affiliates:

COCHRAN, RICHARD F., 93 Grand Ave., Washington
CONOVER, JOHN H., 16 N. Mountain Ave., Montclair
CRUVER, ROBERT, 155 Prospect Place, Bound Brook
DECKER, CLAYTON, Poniton Farm, R.D. 3, Bridgeton
NOTTER, WILLIAM, Village Road, New Vernon
POST, THEODORE, R.F.D. 2, Sussex
POTTER, ALBERT A., c/o De Neef, Branchville
RAHNER, ERWIN, 12 Stamford Ave., W. Orange
SCHEROLZ, JOHN, 36 Lawrence Ave., W. Orange
SHAW, SAMUEL L., 128 Forest St., Belleville
TREGURTHA, JAMES D., 40 Claremont Ave., Bloomfield
WRIGHT, GEORGE, Box 17, Salem

NEW MEXICO

Members:

CUNNINGHAM, O. C., Dairy Dept., College of Agr., State College
JENTGEN, WALTER F., c/o Prices Creameries, Inc., Portales
REEVES, CALVIN B., Dairy Dept., N. Mex. A & M College, State College
*SKAGGS, S. R., Dairy Dept., N. Mex. A & M College, State College
TRETSVEN, WAYNE, Dairy Ind. Dept., N. Mex. A & M College, State College

Student Affiliates:

BIRCHALL, RICHARD P., Box 501, State College
GEORGE, L. D., Box 905, Las Cruces
GILSTRAP, J. W., Gen. Delivery, Las Vegas

NEW YORK

Members:

ALBRECTSEN, RAYMOND, Cornell Univ., Animal Husb. Dept., Ithaca
AYRES, W. E., Dairy Ind. Dept., Cornell Univ., Ithaca
BARBER, FRANKLIN W., Natl. Dairy Research Labs., Oakdale, L. I.
BARTSCH, WALTER C., 205 E. 24th St., New York 10
BAYER, A. H., Dir. of Research & Product, Gen. Ice Cream Corp., 710 Eastern Ave., Schenectady
BEATY, ANNABEL, Natl. Dairy Research Labs., Inc., Oakdale, L. I.
BEAUTES, LOUIS J., Ouaquaga
BEGLEY, KEMP, R.D. 2, Honeoye Falls
BELL, LEWIS S., Interlaken
*BENNETT, S. R., Natl. Milk Sugar Co., Div. of Borden Co., Bainbridge
BOTWINIK, LEONARD, 1288 East 10th St., Brooklyn 30
BOWLING, G. A., Strathglass Farm, Port Chester
BRADT, C. G., Animal Husb. Dept., Cornell Univ., Ithaca
BRADWAY, ELIZABETH M., Borden Lab., 600 N. Franklin St., Syracuse
BRATTON, ROBERT W., Animal Husb. Dept., Cornell Univ., Ithaca
BREED, ROBERT S., Agr. Expt. Sta., Geneva
BREERETON, J. G., Sheffield Farms Co., 524 W. 57th St., New York
*BRESETTE, G. E., Robert Fulton Hotel, 228 W. 71st St., New York 23
BROWNELL, S. J., Animal Husb. Dept., Cornell Univ., Ithaca
BROWNING, R. A., Park & Pollard Co., 356 Hertel St., Buffalo
BURKE, JAMES D., Rt. 4, Ithaca
BURRELL, LOOMIS, Cherry-Burrell Corp., Little Falls
CARNEY, PAUL E., 524 W. 57th St., New York
*CARPENTER, DION, R.D. 1, Alpine
*CARTER, WILMOT, Wing Hall, Cornell Univ., Ithaca
CLAPP, ELMER E. JR., N. Y. State Agr. & Tech. Inst., Canton
CLARIN, DAVID X., c/o Oakite Prod. Inc., 22 Thames St., New York
CLEVELAND, CHARLES, Middletown Milk & Cream Co., Slate Hill
CLOUSE, S. H., 1418 Center Blvd., Springfield
COHEN, HAROLD, 28 Oakman St., Rochester
COHEN, ISAAC, 76 Myrtle Ave., Brooklyn
CORDES, WILLIAM A., Sealtest, Inc., 230 Park Ave., New York 17
CRANDALL, T., N. Y. State College of Agr., Cornell Univ., Ithaca
DAHLBERG, A. C., Cornell Univ., Ithaca
DAVISON, R. O., 31 Nassau St., New York
DETWILER, B. H., The Borden Co., 350 Madison Ave., Room 1115, New York
DIAMOND, MILTON, 520 Washington Ave., Albany
DUBIN, ABRAHAM J., 336 W. End Ave., New York 23
EASTWOOD, H. S., De Laval Separator Co., 165 Broadway, New York 6
FAUST, HOWARD P., 23 Roetzer St., Buffalo 11
FISH, MILTON H., South Edmeston
FOOTE, ROBERT H., Animal Husb. Dept., Cornell Univ., Ithaca
FREIDMAN, AARON, 327 Central Park West, Apt. 5E, New York 25
GARMAN, VICTOR C., 1 Waverly Place, Albany
GAVIN, JOSEPH S., Gavin Dairy Lab., 200 Stockbridge, Buffalo
GILMORE, L. N., 1009 Chamber of Commerce Bldg., Buffalo
GRAHAM, RUSSELL A., 146 Brampton Rd., Syracuse
GREZE, J. P., c/o Oakite Prod., 22 Thames St., New York 6
GURDIAN, MAX, 114 Cobb St., Ithaca
GUTHRIE, E. S., Cornell Univ., Ithaca
HAMILTON, GEORGE B., 61 Broadway, New York
HAMLIN, FRANK H., Paper Machine Co., Shortsville
HARMON, E. M., c/o Natl. Dairy Council, 437 5th Ave., New York 16
HARRIS, THEODORE WM., Hinman Milking Machine Co., Oneida
HEIMAN, VICTOR, Kasco Mills, Inc., Waverly
HENDERSON, CHARLES R., Animal Husb. Dept., Cornell Univ., Ithaca
HENING, J. C., N. Y. State Agr. Expt. Sta., Geneva
HERRINGTON, B. L., Dept. Dairy Ind., Cornell Univ., Ithaca
HERRO, ALEX G., Natl. Dairy Research Labs., Oakdale, L. I.
HESSELSCHWERDT, FRED H., Coop. G. L. F. Mills, Inc, Buffalo
HILEMAN, J. L., Dairymen's League, 810 Burnett, Syracuse
HILKER, LUTHER D., Natl. Dairy Research Labs., Inc., Oakdale, L. I.
HOLLAND, ROBERT F., Dairy Dept., Cornell Univ., Ithaca
HOPSON, GEORGE H., South Road, Millbrook
HOYNAK, P. X., c/o Refined Syrups & Sugars, Yonkers
JANSEN, J. F., 1 Union St., Oneonta
JOHNSON, ARNOLD H., Natl. Dairy Research Labs., Inc., P.O. Box 97, Oakdale, L. I.
JOHNSON, MAURICE A., 103 E. York St., Ithaca
JUDKINS, H. F., 230 Park Ave., New York 17
KERN, CLYDE L., 11 W. 42nd St., 21st Floor, New York 18
KIEDA, ADAM, 341 Washington Ave., Oneida
KISSEN, BENJAMIN, Hygrade Foods Prod. Corp., 30 Church St., New York 7
KNAYSI, GEORGE, Dairy Ind. Bldg., Cornell Univ., Ithaca
KOERVER, C., 524 Waverly Ave., Brooklyn

KOSIKOWSKY, FRANK V., Dairy Bldg., Cornell Univ., Ithaca
KRATZER, CARL R., Borden Co., Arcade
KRAVITZ, MAX, 133 Gorham St., Canandaigua
KRUKOVSKY, V. N., Dairy Ind. Dept., Cornell Univ., Ithaca
LAMB, LELAND W., 213 E. Seneca St., Ithaca
LARSON, C. W., Genl. Ice Cream Corp., Buffalo 3
LAZARUS, N. E., 266 Bryant St., Buffalo 9
LEBER, HENRY, 810 Burnett, Syracuse
LEHMKUHL, HENRY, 73 Howell St., Rochester 7
LIST, W. H., Assoc. of Ice Cream Mfgrs., Hotel Pennsylvania, 7th Ave., New York
LOOSLI, J. K., Animal Nutr. Lab., Cornell Univ., Ithaca
LUNDSTEDT, ERIK, 16 Parkway, Goshen
MARCH, RICHARD, The Knoll, c/o A. H. Treman, Ithaca
MARCUSSEN, WILLIAM H., The Borden Co., 350 Madison Ave., New York 17
MARQUARDT, J. C., 14 Maxwell Ave., Geneva
MASUROVSKY, B. I., 2784 Morris Ave., Bronx 58
MAYNARD, L. A., U. S. Nutr. Lab., Tower Rd., Corneli Univ., Ithaca
MCCHESNEY, E. R., Fairmont Creamery Co., Buffalo
MONRAD, KARL J., Chr. Hansen's Lab., Inc., Little Falls
MOOK, D. E., 32 Secor Rd., Scarsdale
MORRISON, F. B., Animal Husb. Dept., Cornell Univ., Ithaca
MUSHER, SIDNEY, 250 W. 57th St., New York 19
MYERS, E. M., N. Y. School of Agr., Alfred
MYERS, R. P., Natl. Dairy Research Labs., Oakdale, L. I.
NAYLOR, H. B., Dairy Ind. Dept., Cornell Univ., Ithaca
NEWMAN, P. E., Beacon Milling Co., Cayuga
NORRIS, L. C., Rice Hall, Cornell Univ., Ithaca
NORTH, C. E., 23 E. 26th St., New York 10
OWEN, THOMAS S., Dailey Mills Inc., Exchange Natl. Bank Bldg., Olean
PALEY, CHARLES, c/o Certified Labs., Inc., 19 Hudson St., New York 13
PAYNE, IRA G., Box 1259, Albany
PLETCHER, F. H., L. I. Agr. & Tech. Inst., Farmingdale
POWERS, A. J., Borden's Farm Products Co., Inc., Lab. Dept., 90 Third Ave., Brooklyn
QUENCER, ARTHUR B., 620 12th Ave., New York 19
RANDALL, WALDO W., Mount Sinai
REID, J. THOMAS, Animal Husb. Dept., Cornell Univ., Ithaca
RICHARDS, CLYDE R., Wing Hall, Cornell Univ., Ithaca
RIGGS, L. K., Natl. Dairy Research Labs., Inc., Oakdale, L. I.
ROBERTSON, A. H., Director of State Food Lab., N. Y. State Dept. of Agr. & Mkts., State Office Bldg., Albany
ROSS, HARRY ALBERT, Bureau of Econ., The Borden Co., 350 Madison Ave., New York
ROSS, H. E., Cornell Univ., Ithaca
SCHAEFER, O. G., Room 2304, 420 Lexington Ave., New York 17
SCHNEIDER, KILIAN, Arkport
SEMLER, EDWIN L., Churchville
SEYMOUR-JONES, FRANK L., The Borden Co., 350 Madison Ave., New York 17
SHERMAN, J. M., Dairy Ind. Bldg., Ithaca
SMITH, C. A., Special Prod. Dept., Standard Brands, Inc., 595 Madison Ave., New York 22
SPALDING, ROBERT W., Dept. of Animal Husb., Cornell Univ., Ithaca
SPEAKS, CHARLES, Milk Ind. Foundation, Chrysler Bldg., New York
STARK, C. N., Dairy Bldg., Cornell Univ., Ithaca
STOVER, OSCAR H., Hubbard Road, East Aurora
STRACHAN, R. C., 89 East Ave., 9th Floor, Rochester
SUPPLEE, C. G., c/o Supplee Research Corp., Bainbridge
SWANSON, WILLIAM J., Distillation Prod., Inc., 755 Ridge Rd., W. Rochester 19
TAILBY, G. W., Animal Husb. Dept., Cornell Univ., Ithaca
TAUB, JOEL, 40 E. 17th St., Brooklyn 26
THOMPSON, C. E., The Borden Co., 15 Renwick St., New York
THOMPSON, E. C., 1792 E. 22nd St., Brooklyn
TIEDMAN, WALTER VON DOHLEN, 10 Lincoln Ave., Delmar
TJARKS, EDW. A., 52 Main St., Port Washington, L. I.
TRIMBERGER, GEORGE W., Animal Husb. Dept., Cornell Univ., Ithaca
TURK, KENNETH L., Dept. of Animal Husb., Cornell Univ., Ithaca
VAN STRANDER, FREDERIC, 110 Stone St., Oneida
VORPERIAN, JOHN H., 117 Park Lane South, Kew Gardens, L. I.
WALLIS, G. C., Special Prod. Dept., Standard Brands, Inc., 595 Madison Ave., New York 22
*WASHBON, W. E., 97 Kent Blvd., Salamanca
WATERHOUSE, T. P. JR., Bellevue Dairy, 729 Broadway, Schenectady
WEBSTER, H. G. JR., c/o Dairylea Milk Prod. Inc., Wurz Ave., Utica
WEINBERGER, ROBERT I., 951 Carroll St., Brooklyn
WEISSMAN, D. M., 36048 34th St., Long Island City
WENTWORTH, W. A., c/o The Borden Co., 350 Madison Ave., New York 17
WEST, GEORGE A., Rochester Health Bureau, 44 Marshall St., Rochester
WHITAKER, R., Natl. Dairy Research Labs., Oakdale, L. I.
WHITE, JAMES C., Dairy Bldg., Cornell Univ., Ithaca
WILLIAMS, ALEXANDER W., Room 1701, Borden Co., 350 Madison Ave., New York

WILLMAN, H. A., Animal Husb. Dept., Cornell Univ., Ithaca
WILSON, LOGAN T., The Borden Co., 350 Madison Ave., New York 17
WINNING, ROSS J., 524 W. 57th St., New York 19

Student Affiliates:

APICELLA, JOSEPH N., 72 Woods Ave., Roosevelt
BOGART, ALBERT, 1739 Dahill Rd., Brooklyn 23
BUZZELLI, FRANK G., 527 19th St., Niagara Falls
COLLINS, WILLIAM, Animal Husb. Dept., Cornell Univ., Ithaca
DAS, B. G., 210 Linden Ave., Ithaca
DEMNITZ, PETER E., 206 College Ave., Ithaca
FLEISCHMAN, FREDERICK F. JR., 127 N. Quarry St., Ithaca
GARBE, EDWIN, 50 Elgin Rd., Valley Stream
GIBBONS, AUSTIN P., 130 Dryden Rd., Ithaca
GREEN, WILLIAM III, 1701 Union St., Schenectady 6
GRENCI, JOE, 63 LUX St., Rochester 5
HOVEY, GEORGE A., 9 Woodland Pl., Ithaca
JAKEMAN, BROOKS R., Bellain Ave., Harrison
JORDAN, WILLIAM K., 708 E. Buffalo St., Ithaca
KANE, GINJA GANGERDHAR, c/o C. M. McCay, Dairy Bldg., Cornell Univ., Ithaca
LOPP, FRANK J., 461 11th Ave., New York 18
MARLOTT, DONALD DADE, 16 Randall St., Cortland
MCCADAM, LYNDON W., 408 Ford St., Ogdensburg
MCMAHAN, JAMES, 114 176th St., St. Albans, L. I.
MCSER, LAWRENCE R., 3120 Bainbridge Ave., The Bronx 67
MURRAY, WILLIAM THOMAS, 2 Thornwood Lane, Roslyn Hts., L. I.
MUSGRAVE, STANLEY D., Animal Husb. Dept., Cornell Univ., Ithaca
NEWLANDER, HAROLD A., 238 Linden Ave., Ithaca
PENCE, JOHN T., 820 South Ave., Horseheade
PETERSON, JOHN B., Animal Husb. Dept., N. Y. State College of Agr., Ithaca
ROSENBERG, ALVIN S., 161 Nott Terrace, Schenectady
SHAUL, JOHN, Forest Home, c/o Prof. King, Ithaca
SHIPE, W. J. JR., Dairy Ind. Dept., Cornell Univ., Ithaca
STEIN, FRED, 45 Park Terrace, New York 34
STOWE, JAMES R., 105 E. Decker St., Johnstown
THEOKAS, DIONISIOS A., 671 E. Tower Rd., Ithaca
TOMAINO, FRANK A., 634 Elizabeth St., Utica
TOWLE, EDMUND J. JR., 311 S. Manning Blvd., Albany
TUCKER, CHARLES W., 9241 173rd St., Jamaica 3
WAGNER, PAUL F., 527 Northland Ave., Buffalo
WARNER, RICHARD G., Animal Husb. Dept., Cornell Univ., Ithaca
WEDEEN, MARVIN M., 203 Eastwood Ave., Ithaca
YOUNG, HAROLD, 12 Nelson Ave., Ossining

NORTH CAROLINA

Members:

ARBUCKLE, W. S., Animal Ind. Dept., N. C. State College, Raleigh
AREY, J. A., State College Sta., Raleigh
*BRACKETT, CHARLES E., c/o Kraft Foods Co., W. Jefferson
CLEVENGER, W. L., Dairy Dept., State College, Raleigh
*CLINE, G. B., Box 29, Chapel Hill
COLVARD, DEAN W., Dairy Husb. Dept., N. C. State College, Raleigh
ELLIOTT, F. I., Animal Husb. Dept., State College, Raleigh
FAIRES, E. W., Coastal Plain Sta., Willard
GOFORTH, HOWARD J., Coble Dairy Prod., Lexington
GRINNELLS, C. D., State College Sta., Raleigh
HILTON, J. H., N. C. State College, Raleigh
KENNEDY, W. L., A & T College, Greensboro
*KIMREY, A. C., Ext. Dairyman, N. C. State College, Raleigh
LUCAS, HENRY L. JR., Inst. of Statistics, N. C. State College, Raleigh
*MORROW, A. R., 2051 Sharon Lane, Charlotte 7
*ORDERS, W. CARL, 2711 Rosedale Ave., Raleigh
ROBERTS, W. M., Animal Ind. Dept., N. C. State College, Raleigh
RUFFNER, R. H., Animal Husb. Dept., State College Sta., Raleigh
SPECK, MARVIN L., Animal Ind. Dept., N. C. State College, Raleigh
STROBEL, DAVID R., Dairy Div., Dept. of Agr., Raleigh
WAUGH, R. K., Animal Ind. Dept., N. C. State College, Raleigh
WYNN, ROBERT L., Box 68, A & T College, Greensboro

Student Affiliates:

BLANTON, LEONARD F., Animal Ind. Dept., N. C. State College, Raleigh
COLVARD, CHARLES D., Animal Ind. Dept., N. C. State College, Raleigh
COSTILOW, RALPH N., Animal Ind. Dept., N. C. State College, Raleigh
JARVIS, R. N., Animal Ind. Dept., N. C. State College, Raleigh
MCLAUGHLIN, A. L., Animal Ind. Dept., N. C. State College, Raleigh

REDFERN, ROBERT B., Animal Ind. Dept., N. C. State College, Raleigh

SHUMAKER, M. L., Animal Ind. Dept., N. C. State College, Raleigh

NORTH DAKOTA

Members:

BECK, LYLE D., Dairy Husb. Dept., N. Dak. Agr. College, Fargo
BLAND, HARVEY, 208 7th Ave. N. W., Mandan
ESPE, DWIGHT L., Dairy Husb. Dept., N. Dak. Agr. College, Fargo
GAALAAS, R. F., U. S. Dairy Sta., Mandan
JENSEN, C., Dairy Husb. Dept., N. D. Agr. College, Fargo
*KELLY, ROBERT O., Dairy Dept., N. Dak. Agr. College, Fargo
OLSON, CLARENCE C., Dairy Div., NDAC., Fargo

Student Affiliates:

PYLE, J. L., Gen. Delivery, Mandan
SPOONER, JAMES P., N. Dak. Agr. College, State College Sta., Fargo

OHIO

Members:

ALEXANDER, C. B., Akron Pure Milk Co., 273 Bowery St., Akron 8
ALMY, E. F., Dept. of Agr. Chem., Ohio State Univ., Columbus 10
ALTER, JOHN R., 2246 Barrymore Ave., Columbus 3
ANDERSON, O. E., Ohio Dairy Prod. Assoc., 5 E. Long St., Columbus 15
ARMSTRONG, T. V., 44 E. Frambes Ave., Columbus
BABCOCK, WAYNE, 945 Berdan Ave., Toledo
BACHTEL, R. T., The Borden Co., 1112 E. Tuscarawas St., Box 790, Canton
BAISLER, WALTER R., 642 McClurg Rd., Youngstown
BAKER, NEIL R., 239 W. Spring St., Columbus 15
BAUR, L. S., 653 Glenmount Ave., Columbus 2
BECK, ALFRED J., 258 Grandview Ave., Wadsworth
BELL, HENRY, c/o A. W. Bell, Peninsula
BENNETT, C. L., c/o Matthews-Frechtling Dairy Co., 2363 St. James Ave., Cincinnati
BERG, E. K., R.R. 1, Copley
*BICHSEL, WILLIAM J., 139 2nd St. N.W. New Philadelphia
BLACK, F. V., c/o Black's Creamery, 1375 W. Park Ave., Piqua
BLACK, ROBERT, N. Canton Dairies, Inc., North Canton
BLACKMAN, C. D., Ohio State Univ., Columbus 10
BOEHM, GILBERT M., 132 E. Court St., Urbana
BRADFIELD, R. W., Snider Dairy, Baltimore
BRAKEL, WILLIAM J., Plumb Hall, Ohio State Univ., Columbus 10
BURGWALD, L. H., Dairy Tech. Dept., Ohio State Univ., Columbus 10
BURKEY, L. C., Creamery Pkg. Mfg. Co., 500 Broadway, Toledo
CAMPBELL, E. E., White Mountain Creamery Co., 124 W. Wayne St., Lima
CAMPBELL, F. M., Andalusia Dairy Co., Salem
CARMEAN, MATTHEW E., The Borden Dairy, Marion
CAVANAUGH, J. F., American Jersey Cattle Club, Columbus 15
CHARLES, DONALD A., 1132 Piermont Rd., Cleveland 2
CHRYSLER, L. H., 322 S. Roys Ave., Columbus
COMPTON, ERNEST, Field Manager, Isaly Dairy, 2800 N. High St., Columbus 2
COOK, PAUL L., 2969 Mountview Rd., Columbus
CORN, ORVILLE, Meyer Dairy Prod. Co., 3051 E. 63rd St., Cleveland
DANIELS, PAUL, Flordell Farms, Kenton
DAVIS, MYRON E., Beatrice Foods Co., 153, Germantown, Dayton
DENLINGER, H. E., 809 Quimby Ave., Wooster
DENNIS, J. DREXEL, 1441 Plain Ave. N. E., Canton 4
DIEHL, M. W., 275 Pleasant Valley Rd., Cleveland 9
DISSLY, L. P., 3068 W. 106th St., Cleveland 11
DODD, D. R., 201 Townshend Hall, Ohio State Univ., Columbus 10
DRAIN, H. D., Borden's Dairy, 934 Grant St., Akron
DRAKE, MAX, Tiffin
DREYER, VIRGIL O., 219 E. 5th St., Dayton 2
DRUSENDAHL, L. G., 1311 Arlington Rd., Lakewood 7
EBRIGHT, JAMES R., 126 Chatham Rd., Columbus 2
ELLSWORTH, PERRY R., 592 E. Beechwold, Columbus
ERB, J. HOFFMAN, 1697 Berkshire Rd., Columbus 8
*ESHELMAN, RUSSELL H., Hess & Clark, Inc., Ashland
ELY, FORDYCE, Dairy Husb. Dept., Ohio State Univ., Columbus 10
*FORBES, BENJAMIN F., Brecksville
FROHRING, PAUL R., Chagrin Falls
FROHRING, W. O., Box 232, Chagrin Falls
GARRETT, O. F., M & R Dietetic Labs., Inc. 585 Cleveland Ave., Columbus 16
GEBHARDT, H. T., Rt. 5, Marysville
GILMORE, L. O., Dairy Husb. Dept., Ohio State Univ., Columbus 10
*GREINER, FRED J., 954 King Ave., Columbus

GUNTHER, GEORGE E., 1829 E. 55th St., Cleveland 3
HAMILTON, HAROLD, R.R. 1, Burton
HAMILTON, ROBERT, Willard Dairy, Willard
HAMILTON, T. KLINE, Diamond Milk Prod., Inc., 315 Graham St., Columbus
HARMAN, THOMAS D., 325 S. Court St., Circleville
HAYDEN, C. C., 438 N. Buckeye St., Wooster
HELWIG, JOHN H., College of Vet. Med., Ohio State Univ., Columbus 10
HIBBS, JOHN W., Ohio Agr. Expt. Sta., Wooster
HOLESKI, CASHMERE, Oak Hill Rd., Rt. 1, Peninsula
HOLESKI, FRANK, R.F.D. 1, Peninsula
HOLM, WARD, Columbus Milk Dist. Assn., 37 E. Gay St., Columbus 15
JEWELL, R. M., 1103 E. Vine St., Mt. Vernon
JOHNSTON, FLOYD, American Jersey Cattle Club, 107 N. 6th St., Columbus 15
JOHNSTON, W. L., Westerville Creamery Co., Westerville
KAESER, HAROLD, 4871 Olentangy Rd., Columbus 2
KELLOGG, RICHARD H., 1224 Alton Darby Rd., Columbus 4
KENNEDY, ROLAND N., 165 N. Washington Ave., Columbus 16
KESSELRING, L. M., Kesselring Dairy, 1559 Triplett Blvd., Akron 6
KNOOP, C. E., Ohio Agr. Expt. Sta., Wooster
KOCH, IRVING O., Borden Dairy & Ice Cream Co., Columbus 16
KOLAR, RAYMOND E., 702 Broadway, Piqua
KRAUSS, WILLIAM E., Ohio Agr. Expt. Sta., Wooster
KRILL, W. R., Vet. Clinic, Ohio State Univ., Columbus 10
LEHMAN, LESTER, 1302 Irving Ave., Cleveland 9
LENGACHER, JOHN, Rt. 1, Dundee
LOWE, ROBERT W., 940 Washington Ave., Cuyahoga Falls
LUDWICK, THOMAS M., Dairy Husb. Dept., Ohio State Univ., Columbus 10
LYMAN, J. F., Ohio State Univ., Columbus 10
MAPP, GEORGE R., R.R. 1, Troy
MARCY, CHARLES, Mt. Sterling
MARTIN, ROBERT L., Apt. C, 325 Union St., Newark
MCBRIDE, CHARLES GROVER, 2212 Glouster Rd., Columbus 12
MCCLURE, ROBERT J., 1957 Coventry Rd., Columbus 8
MCGREW, C. D., Plumb Hall, Ohio State Univ., Columbus 10
MCMUNN, EARL, 1013 Rockwell Ave., Cleveland 14
MEEKS, BENTON, 12022 Lena Ave., Cleveland 11
MEISTER, ARTHUR E., 650 Leonard St., Toledo
MILLER, ROY, R.R. 2, Canton
MINDLING, LUTHER E., 198 N. Roosevelt Ave., Columbus 9
MONROE, C. F., Ohio Agr. Expt. Sta., Wooster
MOORE, C. M., Cowles Detergent Co., 7016 Euclid Ave., Cleveland 3
NADELIN, EUGENE PAUL, 819 Quimby Ave., Wooster
NASS, ED, Canfield
NISBET, J. C., Box 1614, Columbus
OTTING, H. E., 2701 Minerva Lake Rd., Columbus 11
PATTON, STUART, Dairy Tech. Dept., Ohio State Univ., Columbus 10
*PAXTON, JOHN, 29 E. Norwich Ave., Columbus
PERKINS, A. E., Exp. Sta., Wooster
PFEFFER, JOHN C., 7204 Montgomery St., Cincinnati 13
POUNDEN, WILLIAM D., Dairy Dept., Ohio Agr. Expt. Sta., Wooster
PRATT, H. R., 226 Denison Ave., Elyria
PUTNAM, DEXTER N., Prod. Testing Dept., American Jersey Cattle Club, Columbus 15
RAMSEY, R. J., 21853 Cromwell, Rocky River Branch, Cleveland
RATHBUN, GORDON P., 111 E. Forest St., Clyde
RENICK, RALPH O., 13711 Milan Ave., E. Cleveland
*RENNER, KENNETH R., Dairy Tech. Dept., Ohio State Univ., Columbus 10
RHOADES, PAUL L., 2776 Albrecht Ave., Akron
ROSS, RICHARD M., Box 959, Columbus 16
SALISBURY, S. M., Animal Husb. Dept., Ohio State Univ., Columbus 10
SCHELLINGER, KERN K., 514 Woodbury Ave., Columbus 4
SCHILLING, R. L., R.R. 1, Farmersville
SCHROER, C. J., 137 N. 8th St., Upper Sandusky
SELL, C. G., 615 Dayton Ave., Springfield
SEWELL, W. E., Procter & Gamble Co., M A & R Bldg., Ivorydale 17
SHAFER, REED, Box 132, Greenville
SHAFFER, WESLEY A., 1937 Northwest Blvd., Columbus
SHELTON, ELBERT M., Baker Labs., Inc., 2000 W. 14th St., Cleveland 13
SLATTER, WALTER L., Dairy Tech. Dept., Ohio State Univ., Columbus 10
SMITH, DUKE L., 2875 W. 130th St., Cleveland 11
SMITH, JAMES T., Box 5587, Cleveland 1
SOPKO, PAUL M., c/o Isaly Dairy, 2800 N. High St., Columbus 2
SPRAGUE, A. L., Jackson Center Creamery, Jackson Center
STARBUCK, RAYMOND R., Plumb Hall, Ohio State Univ., Columbus 10
STANSBURY, JAMES L., 773 Bulen Ave., Columbus
STEINER, JOHN, Akron Pure Milk Co., 273 W. Bowery St., Akron
STIVER, HUGH F., Rt. 2, Lewisburg
STOLTZ, PHILLIP C., 1971 Concord Rd., Columbus

STUCKEMAN, HOWARD W., Box 165, Kinsman
SUTERMEISTER, L. A., The Red Wing Corp., Dayton 1
SUTTON, T. S., Animal Husb. Dept., Ohio State Univ., Columbus 10
SWINEHART, MICHAEL F., 3740 Carnegie Ave., Telling-Belle Vernon Co., Cleveland 15
THOMAS, ROBERT C., U.S. Pub, Health Serv., 3rd & Kilgour Sts., Cincinnati
TITUS, R. W., Control Lab., Nestles Milk Prod., Marysville
TRAVER, LESTER, 206 Adrian St., Delta
TUCKER, HUBERT, Worthington
*TUCKER, WALTER S., 5015 Monroe St., Box 129, Sta. B, Toledo
VAN BUREN, RALPH, 15 Boehler St., Tiffin
VROMAN, V. S., Defiance Milk Prod. Co., Defiance
WAGNER, WILLIAM, Canal Fulton
WAY, H. O., 2403 Prospect Ave., Cleveland 15
WEHR, C. G., 725 East Ave., Hamilton
WEISER, HARRY H., Dept. of Bact., Ohio State Univ., Columbus 10
WICKHAM, J. C., 4227 W. 36th St., Cleveland
WILLARD, H. S., Dairy Tech. Dept., Ohio State Univ., Columbus 10
WILSON, HORACE K., 330 E. Paint St., Washington C. H.
WISCHHUSEN, J. F., 15031 Shore Acres Dr., Cleveland 10
WOEBKENBERG, NORBERT H., 1345 Joseph St., Cincinnati 29
WOODYARD, W. O., Cudahy Packing Co., Washington C. H.
ZIMMERMAN, HARLIE F., 2564 Portsmouth Ave., Toledo 12

Student Affiliates:

ABELL, CARL, Medina
ANGERSBACH, W. HOWARD, R.D. 2, Amherst
BAHLER, KEITH, 658½ Chestnut St., Coshocton
BAKER, LEE, 1088 E. Main St., Columbus
BAKER, R. F., 2010 Elmwood Ave., Columbus 12
BARTELS, JOHN, R.F.D. 1, Wellsville
BEARDSLEY, JOHN E., 2208 Indiana Ave., Columbus
BROWN, KENNETH, Rt. 2, Cortland
CLAY, FRED, 1478 N. 5th St., Columbus
COBB, OTIS, 115 Garst, Dayton
CONNELLY, ROBERT M., 27 Boulevard, Shelby
COOPER, PAUL, 33 14th Ave., Columbus
CRAPNELL, STEARNS B., Belle Center
CURTIS, THOMAS A., 820 Bryden Rd., Columbus
FISCHER, JESSIE, Baker Hall, Box 219, Ohio State Univ., Columbus 10
FISCHER, R. E., 354 E. Northwood Ave., Columbus
FOOR, ROBERT, R.R. 2, Carroll
FOSTER, DEAN, R.R. 3, London
FOWLER, WILLIAM, 609 Spruce St., Caldwell
FOX, CARMEAN, 97 E. Maynard Ave., Columbus 2
FROST, DON, 208 Park Ave. S. W., Canton
FRYE, J. B., 132 N. Sandusky St., Delaware
GEIGER, HAROLD, 33 14th Ave., Columbus
GIFFORD, MYRON L., Rt. 1, Galena
GLASS, DALE, 3377 Kenny Rd., Columbus 2
HARPSTER, ROBERT, Jeromesville
HAWTHORNE, MORRIS, 126 Chittenden Ave., Columbus
HERSHBERGER, RUSSELL C., 126 W. Lane Ave., Columbus
HOOVER, SID, 461 E. Sandusky St., Findlay
HOWE, DON, 2097 Summit St., Columbus 1
HULLINGER, BRUCE, 121 Northridge Rd., Columbus 1
JONES, CHARLES L., 68 W. Maynard Ave., Columbus 2
KALAPA, C. D., 96 McMillan Ave., Columbus
KISHMAN, GEORGE H., Rt. 2, Huron
LADRACH, GENE, 1597 Neil Ave., Apt. A, Columbus
LANDO, J. C., 4494 Noble St., Bellaire
LEIN, VERNON, 427 Linwood Ave., Columbus 5
LEWIS, JOHN, 1497 Perry St., Columbus
LEWIS, RICHARD, 1497 Perry St., Columbus
LONGHENRY, GEORGE W., 151 E. College Ave., Westerville
LUTZ, HARRY C., Dairy Husb. Dept., Ohio State Univ., Columbus 10
MARTIN, FORREST, 58 W. 10th Ave., Columbus
MATHUR, P. D., 125 W. 9th Ave., Columbus
McKELVEY, GENE, Rt. 1, Creston
McKELVEY, PAUL, 4480 Lincoln Ave., Shadyside
MOORE, WILBUR V., Pleasant City
PANIGOT, EUGENE, 130 Brady Circle, Steubenville
PETERSON, RAYMOND D., 1925 E. Hudson St., Columbus
POPLIN, PARRY, 86 W. Main St., Carrollton
QUEEN, WILLIAM, South Vienna
REVELOS, GEORGE, 133 W. Frambes Ave., Columbus
RICE, ERNEST, 758 Amhust Rd. N. E., Massillon
ROSENBERGER, JAMES H., 22300 Parnell Rd., Shaker Heights 22
RYSER, FRED, Sugar Creek
SHIFFERMILLER, W. E., 806½ N. Main St., Dayton
SMOOTS, EDWIN, 2382 Brentwood Rd., Columbus
SPRANG, RALPH A., 342 N. Leighton St., Kenton
SQUIRES, HAROLD, 76 W. Woodruff Ave., Columbus 1
STAFFORD, JOHN R., R.F.D. 2, Tipp City
SUMNER, GEORGE, 320 Kendall Pl., Columbus 5
SUTERMEISTER, R. L., 71 W. Norman Ave., Dayton 5
TISHER, KENNETH, 2975 E. Market St., Warren

WEBER, EDWARD, 416 Glenwood Ave., Cincinnati 29
WEBER, ED, Rt. 2, Box 43, Lewisville
WEST, ERIC E., River Road Dorm, Ohio State Univ., Columbus 10
WHITTAKER, ARNOLD, 4409 Westway, Toledo 12
ZECK, MLADDEN, 88 W. 9th Ave., Columbus
ZINK, WILLIAM, 922 Main St., Hamilton

OKLAHOMA

Members:

BAUMGARDNER, F. G., 1424 N. Delaware, Tulsa 6
BEROUSEK, E. R., Dairy Dept., Okla. A & M, Stillwater
BOEHR, JOHN W., Ext. Serv., Okla. A & M, Stillwater
*BURKEY, JOHN P., 835 E. 2nd St., Cushing
CALVERT, RICHARD W., Ardmore
CASS, EARLY R., Box 1438, Tulsa
CAVE, H. W., Dairy Husb. Dept., Okla. A & M College, Stillwater
CROWNOVER, WILLIAM M., Box 52, Pawhuska
HOLLAND, THEODIES H., Langston Univ., Langston
JOHNSON, PAUL E., Dairy Dept., Okla. A & M College, Stillwater
KUHLMAN, A. H., Dairy Dept., Okla. A & M College, Stillwater
*LEWIS, J. C., 319 W. Pierce, Mangum
LOEWENSTEIN, MORRISON, Dept. of Dairying, Okla. A & M College, Stillwater
*MCVICAR, ROBERT, Agr. Chem. Research, Okla. A & M College, Stillwater
MCGILLIARD, P. C., Dairy Dept., Okla. A & M College, Stillwater
OLSON, H. C., Dairy Dept., Okla. A & M College, Stillwater
SCHWARZ, LEE R., Carnation Co., of Okla., Tulsa
STINNETT, L. H., Ext. Serv., Okla. A & M College, Stillwater
TRZCINSKI, SAM C., 2030 Denver, Muskogee

Student Affiliates:

BAKER, JAMES B., 102 Stadium, Stillwater
BRUNK, BILLY J., Rt. 3, Cordell
BURBA, VIRGIL, Box 1, Tuttle
COHENOUR, FRANCIS D., Armour Co., Woodward
EDMONDSON, LOCKE, 1411 Hartford St., Stillwater
FOSTER, WILLIAM E., 113 N. Knoblock, Stillwater
GATHER, WAYNE E., c/o Hawk Dairies, 2429 E. 11th St., Tulsa
GUYER, DAN, 1204 S. W. 31st, Oklahoma City
HIGBEE, GEORGE L., Box 1313, Bartlesville
JANDER, JOHN C., 410 S. Seminole, Okmulgee
KINDELL, GEORGE P., Checotah
MACKEY, WILLIAM RALPH, Checotah
MCCRUM, ROY B., 1013 South 16th, Chickasha
MOCHOW, CARL R., Box 56, Bartlesville
MORRIS, ORVAL L., 721 S. Guthrie, Tulsa
NICHOLS, ROBERT J., 205 S. Pine, Ponca City
O'HALLORAN, MERKLE, Box 158, Cordell
PARHAM, BILLY S., County Agent's Office, Tahlequah
PARHAM, LLOYD, County Agent's Office, Tahlequah
PARKER, GEORGE M., Unit 10, Apt. 7, S. Village, Stillwater
REECE, M. F. JR., Rt. 2, Stillwater
RUTZ, WILLIAM D., 302 Knoblock, Stillwater
SCHMIDT, KENNETH F., 210 N. G St., Muskogee
SMITH, JOHN A., 1207 College Ave., Stillwater
STAHL, RUTH E., 408 Duck St., Stillwater
STOKES, WILLIAM B., 406 Lewis, Stillwater
SUMMERS, LEO M., 209 W. 9th, Tulsa
TAYLOR, CECIL E., 420 Texas Ave., Woodward
WALTER, PAUL, 240 Husband, Apt. 1, Stillwater
WEEKS, N. S., Unit 8, Apt. 10, Vet Village, Stillwater

OREGON

Members:

*BRANDT, LEWIS C., 28 N. 22nd St., Corvallis
BRANDT, P. M., Oreg. State Agr. College, Animal Ind. Dept., Corvallis
*BEYERS, JOHN H., Dairy Dept., Oreg. State College, Corvallis
ELLIKER, P. R., Bact. Dept., Oreg. State College, Corvallis
EWALT, H. P., 209 Dairy Bldg., Oreg. State College, Corvallis
GEORGE, J. S., Tillamook County Creamery Assn., Tillamook
*GRIMES, RANDALL E., Harrisburg
HAAG, J. R., Agr. Expt. Sta., Corvallis
HANAWALT, EUGENE M., Box 58, Coos Bay
HENRY, W. W., Dairy Coop. Assn., 1313 S. E. 12th Ave., Portland 14
HOWELL, R. B., Rt. 1, Box 921, Expt. Sta., Astoria
JONES, IDWAL R., Dairy Dept., Oreg. State College, Corvallis
KEYSER, H. C., Dairy Supply Co., Inc., 506 S. E. Union Ave., Portland
*KLAUS, FRED C., 138 S. Liberty, Salem
*LONGWELL, BRYANT R., Consolidated Food Co., Cornelius
MCKENZIE, FRED, Oreg. State College, Corvallis
MILLER, DONALD, Bact. Dept., Oreg. State College, Corvallis

MORSE, ROGER W., Ext. Dairyman, Oreg. State College, Corvallis
MUNTZ, BENJAMIN W., 2845 N. E. 77th Pl., Portland
OLOUFA, MOHAMED M., Animal Husb. Dept., Oreg. State College, Corvallis
RICHARDSON, GEORGE A., Dairy Husb., Oreg. State College, Corvallis
*ROWE, GORDON A., Rt. 4, Box 7, Corvallis
STEIN, ROY W., 1313 S. E. 12th St., Portland
SWANSON, EDGAR H., 2829 S. E. Belmont St., Portland 15
WAGGONER, RALPH W., Box 333, Klamath Falls
WEBSTER, HARRY L., Clatskanie
WILSTER, G. H., Dairy Husb. Dept., Oreg. State College, Corvallis

Student Affiliates:

BALMER, ROBERT, 3751 S. E. 122nd Ave., Portland
BALSARA, DARIUS S., Dept. Food Tech., Oregon State College, Corvallis
BERGER, PAUL, Rt. 3, Albany
BURCH, ISAAC M., 953 Monroe St., Corvallis
CORNETT, JOHN A. SR., 32 N. 26th St., Corvallis
COWGILL, ERWIN R., Rt. 2, Box 363, Tigard
CROUSE, WALTER H., Rt. 4, Box 27, Grants Pass
FISHLER, BERNARD R., 744 S. 14th St., Corvallis
HANSEN, HAROLD W., Theta Xi, 15th & Van Buren Sts., Corvallis
HENRY, WARREN, Prineville Creamery, Prineville
JACOBS, B. L., Rt. 4, Box 181 Corvallis
JENKENS, RANSOME, Box 93, Gresham
JOHNSON, CLARENCE E., 1116 Fairhaven, Apt. 6, Roseburg
KENT, R. A., 330 N. 9th St., Corvallis
KONAR, M. R., May Flower Dairy, 2315 Fairground Rd., Salem
LILES, CHARLES V., Rt. 1, Box 924, Venita
LUFT, DANIEL A., 4941 N. E. 14th Pl., Portland 11
MORGAN, WILBUR, Rt. 1, Box 27, Woodburn
MURREY, RODNEY, 812 Pacific Terrace, Klamath Falls
RACKLIFF, ELLIS, 534 S. Henry, Coquille
STREIFF, ROBERT, Weatherford Hall, Men's Dorm, Corvallis
TAGG, ROBERT, Rt. 1, Box 506, Warrenton
WALTERS, ALLAN, Rt. 1, Box 314 A, Gresham
YOUNG, ORVILLE, 207 N. 21st St., Corvallis

PENNSYLVANIA

Members:

ALMQUIST, JOHN O., Dairy Husb. Dept., Pa. State College, State College
ALWINE, WILBERT W., Somerset Pike, Johnstown
ANDERS, HERBERT K., Agr. Ext. Assn., Box 487, Williamsport
ARNOLD, RICHARD N., R.D. 9, York
AUSTIN, CARLTON J., Supplee-Wills-Jones Milk Co., 15 S. 34th St., Philadelphia
BARNHART, JOHN L., Swede Road, Norristown
BEAM, A. LELAND, 141 Ridge Ave., State College
BENNY, WALTER, 195 E. Main St., Bradford
BORLAND, A. A., Dairy Husb. Dept., Pa. State College, State College
BRACKE, GEORGE M., Rieck-McJunkin Dairy Co., 1345 Forbes St., Pittsburgh
BROCK, O. CARLYLE, 519 E. 18th St., Erie
BRYAN, PAUL S., R.D. 1, Perkasie
CLARK, JOHN I., DuBois Dairy Co., Dubois
CLAXTON, A. J., Meadow Gold Dairies, Inc., 126 Denniston Ave., Pittsburgh
COHEE, C. I., Phila. Inter-State Dairy Council, 234 S. 22nd St., Philadelphia
COLDREN, JOHN, Chester Springs
COLEMAN, PAUL E., R.D. 1, Wexford
COLEMAN, W. B., 6635 McCallum St., Philadelphia
CONE, J. FRANK, Bact. Dept., Pa. State College, State College
CONNELL, F. M., R.D. 2, Edinboro
DAHLE, CHESTER D., Dairy Dept., Pa. State College, State College
DAWDY, MAX L., Dairy Husb. Dept., Pa. State College, State College
DEUBLER, E. C., Bucks County, Newtown
DOAN, F. J., Dairy Dept., State College
DOZIER, EMMITT, JR., 714 Fordham Ave., Brooklin, Pittsburgh 26
DUTCHER, R. ADAMS, 254 E. Hamilton Ave., State College
EDINGER, FLOYD G., 429 N. Main Ave., Scranton 4
FOLKERS, E. C., 5521 Beverley Place, Pittsburgh 6
GALLIKER, LOUIS, Galliker Ice Cream Co., 452 Franklin St., Johnstown
GEARHART, C. R., Pa. State College, State College
GEYER, FRANK E., 601 Laver Rock Rd., Glenside
GIFFORD, C. G., 1692 Pioneer Ave., Pittsburgh 26
GILMORE, HERBERT C., 213 Dairy Bldg., State College
GLICK, D. P., 508 Sylvan Ave., Glenolden
GOSSER, HAROLD, 409 Warrington Ave., Pittsburgh
GREENLEAF, FREDERICK M., 1724 Congress St., Allentown
GROW, WALTER, Fluid Milk Plant, 265 Beech St., Pottstown
GUERRANT, N. B., Pa. State College, State College
*HADFIELD, WILLIAM A., Penn. Salt Mfg. Co., 100 Widener Bldg., Philadelphia
HAMOR, WILLIAM A., Mellon Inst., 4400 Fifth Ave., Pittsburgh 13

HEBERLIG, G. WAINE, 575 N. Plum St., Lancaster
HIDINGER, ORVIS, 204 Times Bldg., Penn Ave. & Spruce St., Scranton
HORN, DAVID WILBUR, Box 666, Bryn Mawr
JAGGARD, GEORGE, 2300 Locust St., Philadelphia 3
JOHNSON, H. S., 119 Federal St., Pittsburgh 12
JOHNSON, LAWRENCE W., Whitmoyer Labs., Inc., Myerstown
JONES, P. D., Dairy Dept., Pa. State College, State College
JOSEPHSON, D. V., Dairy Dept., Pa. State College, State College
JUZI, WILLIAM E., Guernsey Breeders Assn., 1211 Payne Shoemaker Bldg., Harrisburg
KEEN, ROBERT H., Queen Dairy Co., Inc., 413 S. Queen St., Lancaster
KILGORE, JAMES, Rt. 1, Northampton
KING, CLIFTON J., Box 25, Armstrong Co., Dayton
KIRK, J. J., 409 Maple Ave., DuBois
KNODT, C. B., Dairy Husb. Dept., Pa. State College, State College
LANDES, WILLIAM L. S. JR., 2301 W. Market St., York
LANG, JULIUS F., 7831 Devon St., Philadelphia 18
LAUGHLIN, JOHN, Menzie Dairy Co., 1909 River St., McKeesport
LAWHORN, ROBERT K., 397 E. Upsal St., Philadelphia 19
MCCANDLESS, J. COULTER, R.D. 5, Butler
MCCLURE, JOSEPH W., New Wilmington
MCGRAIL, GERALD, 3010 N. 3rd St., Philadelphia
MCMICHAEL, HARRY S., Meadow Gold Dairies, Inc., 126 Denniston Ave., Pittsburgh 6
MELICK, LA RUE T., 426 Memorial Ave., Grove City
MERRILL, HOWARD J., Box 172, State College
MOORE, ROBERT B., 1808 W. 24th St., Erie
MOORE, R. F., 414 N. Jefferson St., New Castle
NAGEOTTE, JOE, Dairy Ext. Spec., 213 Dairy Bldg., State College
OLMSTEAD, R. H., Dairy Bldg., Pa. State College, State College
OTTO, B. FRANK, Otto Suburban Dairy, Inc., Camp Horne Rd., Box 4198, Bellevue, Pittsburgh
PARKHURST, RAYMOND T., Flory Milling Co., Bangor
PARKIN, IVAN E., Room 213, Dairy Ext., State College
PECORA, PASQUO P., Pecoradale Farms, Drums
PERRY, N. A., Dairy Bldg., Pa. State College, State College
PILE, WAYNE W., 150 W. Church St., Somerset
PRATT, HAROLD T., Philadelphia Dairy Prod. Co., 4th & Poplar Sts., Philadelphia
RAHAUSER, GEORGE W., 5028 Smithfield Rd., Drexel
RIETH, HOWARD W., R.D. 1, Box 96, Perkasie
*ROBINSON, CLYDE S., Coal Center
ROHLF, JOHN A., Farm Journal, Inc., Washington Square, Philadelphia 5
ROLAND, CHARLES T., Box 1346, Calgon, Inc., Pittsburgh
*ROSENBAUM, ROBERT, 3743 D St., Philadelphia 24
*ROUGHT, GEORGE B., Nicholson
RUETER, FRED A., Homestead Valve Mfg. Co,. Coraopolis
SALER, MORTON, Apt. 203, Wynnewood Plaza, Wynnewood
SAMPEY, J. J., Abbotts Dairies, Inc., 238 Lombard St., Philadelphia 47
SCOTT, JOSEPH C., R.R. 1, McCoy Rd., McKees Rocks
SEIPT, WILBUR, Oakleaf Farm, Lansdale
SHAFFER, HARVEY E., Dairy Husb. Dept., Pa. State College, State College
*SMITH, ROBERT T., 311 Chamber of Commerce, Scranton
SPUR, BERNHARD, 4317 Spruce St., Philadelphia 4
STAZ, JOHN M., East End Dairy, 19th & Brookwood Sts., Harrisburg
SWOPE, W. D., Pa. State College, State College
TAYLOR, JOE S., Dairy Bldg., Pa. State College, State College
WALKER, H. S., 623 15th Ave., Bethlehem
WATROUS, G. H. JR., Dairy Husb. Dept., Pa. State College, State College
WELCH, R. C., Wilbur Suchard Chocolate Co., Lititz
WILLIAMS, PAUL S., Dairy Bldg., State College
WILSON, H. KENNETH, 612 S. 24th, Sylvan Seal Milk Inc., Philadelphia 46
WOODRUFF, ALFRED C., 42 Locust Ave., Springfield
ZIMMERMAN, JOS. A., Lehighton

Student Affiliates:

ANZOATEQUI, FERNANDO, 5044 Larchwood Ave., Philadelphia
AULL, WILLIAM F. JR., Dairy Bldg., Pa. State College, State College
BALDWIN, DONALD H., 417 E. Prospect St., State College
BISEL, RICHARD S., 908 Boyd St., Johnstown
CLAYCOMB, JEANNE, 459 W. Pitt St., Bedford
CLOSSER, E. R., R.D. 4, Waynesburg
COLLINS, WILLIAM F., 108 Dairy Bldg., State College
COLTERYAHN, CARL A., 110 Brentridge Ave., Pittsburgh 27
COLVIN, HARRY W. JR., Ruthfred Acres, R.D. 2, Bridgeville
COOPER, GLENN H., 163 Martin St., Red Lion

CULP, WILLIAM R., 238 E. Foster Ave., State College
DUNMIRE, RAYMOND A., McVeytown
EDINGER, ROBERT W., 711 W. Foster Ave., State College
FELCHER, JOHN E., R.D. 4, Easton
FRAILEY, GERARD E., R.D. 3, Lancaster
FRANTZ, HAROLD E., 644 Main St., Bressler
FYOCK, W. DEAN, 206 Dairy Bldg., State College
GROBMAN, SYDNEY, 2625 S. 9th St., Philadelphia 48
HEIDELBAUGH, GEORGE D., 335 E. Lancaster Ave., Wynnewood
HINKELMAN, CLIFFORD, R.D. 2, Logan Station
HOGG, ROBERT ARTHUR, 520 McKee St., State College
HOOVEN, NORMAN W. JR., 1042 Windcrest, State College
HURON, FRANK W., 618 S. Pugh St., State College
KESLER, EARL M., Dairy Dept., State College
KIRK, FRANCIS L., Peach Bottom
LESLIE, JOHN I. JR., Warren State Hospital, Warren
LUKACS, GEORGE P., R.D. 6, Mercer
MATTICK, JOSEPH F., 210 S. Sparks St., State College
MATTICK, LEONARD R., 210 S. Sparks St., State College
MAYER, C. WM., Alpha Zeta Campus, State College
MCDANEL, JAY R., R.D. 2, Beaver Falls
MCKOWN, ROBERT M., 827 W. College Ave., State College
NAUGLE, JOHN DAVID, R.D. 1, Hooversville
PAINTER, HERVEY M., Rt. 1, State College
PETRUNCHIK, ANDREW, 427 Fifth St., Taylor
RANCK, SAMUEL H., R.D. 7, Lancaster
RONNING, MAGNAR, Dairy Husb. Dept., Room 206, Pa. State College, State College
RUMBAUGH, FRANK H., 226 S. Frazier St., State College
SAFF, KENNETH H., R.F.D. 1, Kane
SHOPE, FRANK L., 236 E. Foster Ave., State College
SMITH, ARNOLD C., 108 Dairy Bldg., State College
SMITH, VERNON T., JR., 615 Maple Ave., DuBois
STAHL, GEORGE R., Whitehall Rd., State College
STEFFEN, JAMES E., 489 W. Fourth, Lewistown
STEIN, CHARLES M., 507 Curtin St., Osceola Mills
STEWART, ANDREW, 520 Holmes St., State College
STRUNK, ELMER F. JR., Torresdale, Box 6018, Philadelphia 14
SUTHERLAND, JACK K., 1801 Polk St., Aliquippa
TRUITT, GERALD B. JR., 622 W. Beaver Ave., State College
UNANGST, DONALD M., 113 N. Irvine St., Warren
WASSELL, JOHN H., 103 E. Park St., State College
WHEELER, ROBERT C., 38 W. Harrison St., Tunkhannock
WILDASIN, HARRY, 127 S. Bernard St., State College
WILLIAMS, JESSE B., 206 Dairy Bldg., State College
WILSON, JOHN C., R.F.D. 2, Beaver Falls
YEATMAN, ARTHUR P., Sigma Phi Alpha, 134 E. Foster Ave., State College

PUERTO RICO

Members:

BRENES, LUIS RIVERA, Agr. Expt. Sta., Rio Piedras
MARTORELL, MIGUEL A., Box 28, Dorado
WIEDEMER, ARTHUR, Dairy Manager, Puerto Rico Agr. Co., San Juan 22

RHODE ISLAND

Members:

ARMSTRONG, ROBERT E., 102 Summitt St., E. Providence
*ATWOOD, JOHN W., R. I. State College, Kingston
*BUCHANAN, JOHN O., R. I. State College, Kingston
CAMPBELL, MASON, Kingston
*GRAY, A. B., 3 Oak St., Westerly
*HAVENS, ELMER A., 511 Westminster St., Providence
HENDERSON, B. W. JR., Fort Kearny, Saunderstown
NORTON, CHARLES L., R. I. State College, Kingston
PERISHO, GEORGE D., R.R. 5, Greenville
*SMITH, WILLIAM T., 172 Berkshire St., Providence

Student Affiliates:

DEYOUNG, RAYMOND C., 547 Academy St., Providence
SWANSON, ROBERT G., 62 Waldron Ave., Cranston 10

SOUTH CAROLINA

Members:

*BARNETT, GEORGE M., Dairy Dept., Clemson College, Clemson
*BOWERS, TRUMAN S., Dairy Dept., Clemson College, Clemson
BRANDT, GRAYDON W., Dairy Dept., Clemson College, Clemson

*Brannon, Carroll C., Dairy Dept., Clemson College, Clemson
Breazeale, Thomas C. Jr., Dairy Dept., Clemson College, Clemson
*Cobb, E. D., Pet Milk Prod. Co., Greenville
*Fletcher, O. J., McColl
*Gee, Gaston, State Farm, Boykin
Goodale, B. E., Clemson College, Clemson
*Gulledge, E. P., Gallison
*Hanckel, F. S., Coburg Dairy, Charleston
*Hellams, J. I., Greenwood Creamery Co., Greenwood
*Hiers, Jesse C., c/o County Agent, Anderson
Hobson, W. M., Foremost Dairies, Spartanburg
*Kapp, Robert P., Edisto Farms Dairy, Columbia
*Kelly, J. W., 110 Jackson St., Greer
LaMaster, J. P., Dairy Dept., Clemson College, Clemson
*Lazar, James T., Dairy Dept., Clemson College, Clemson
Lomas, C. H., Clemson
*Lykes, H. P., Lykesland
*Lyle, John W. Jr., Clemson
*McGee, Ralph H., Coburg Dairy, Charleston
*McGregor, Rhett, M., Lykesland
*Rhodes, Luther M. Jr., Box 766, Orangeburg
*Smith, Clifford T., Kinards
*Stroud, W. Crawford, Great Falls
*Whisenhunt, Henry L., Mimosa Farm, Cope

Student Affiliates:

Brown, C. G. Jr., 608 Boulevard, Anderson
Carter, L. D., Ehrhardt
Causey, J. F., 146 Newman Circle, Clemson
Frazer, S. M. Jr., 130 Columbia St., Chester
Hagen, J. G., Box 457, Clemson College, Clemson
Hurst, Victor, Dairy Dept., S. C. Agr. Expt. Sta., Clemson
Shuman, C. M., Box 1186, Clemson
Watson, C. K., Box 1464, Clemson

South Dakota

Members:

Battle, Emery, Box 3, College Sta., Brookings
Breazeale, D. F., Dairy Husb. Dept., S. Dak. State College, Brookings
Cave, R. A., S. Dak. State College, Brookings
Dracy, Arthur E., Dairy Husb. Dept., S. Dak. Coll. of Agric., Brookings
Edwards, William Chas., Tyndall
*Hansen, D. L. R., Ext. Dairyman, College Sta., Brookings
*Johnson, Leslie E., Animal Husb. Dept., College Sta., Brookings
Kelly, P. L., Dairy Dept., State College Sta., Brookings
Larsen, Dean Chris, S. Dak. State College, Brookings
Haines, A. L., 631 St. Charles, Rapid City
Schock, Alvin A., Dairy Husb. Dept., S. Dak. State College, Brookings
Totman, C. C., Dairy Dept., S. Dak. State College, Brookings

Student Affiliates:

Anderson, William, Dairy Dept., S. Dak. State College, Brookings
Andrisen, Hartney, Barracks 194, College Sta., Brookings
Johnson, Enoch, Dairy Dept., S. Dak. State College, Brookings
Natvig, Norman, Box 420, College Sta., Brookings
Oviatt, Max, 810 12th Ave., S. W., Huron

Tennessee

Members:

Armstrong, W. H., 4222 S. Garden Rd., Knoxville
Brew, James D., 2023 Terrace Ave., Knoxville
*Carithers, R. L., 1019 E. Main St., Murfreesboro
Carringer, Herman N., Univ. of Tenn., Dairy Dept., Knoxville
*Chappell, Clyde, Dis. Dairy Spec., Nashville
Colebank, L. O., Agr. Ext., Univ. of Tenn., Knoxville
Copeland, Lynn, Univ. of Tenn., Nashville
*Dougherty, A. F., Southern Dairies, 601 Oak St., Knoxville
Friend, L. S., 1497 Union Ave., Unit 4, Memphis
Garrecht, Hubert, Klinke Bros. Dairy, 2469 Summer Ave., Memphis
Harrison, Thomas B., 2307 Laurel Ave., Knoxville
Hervey, Marshall C., Animal Husb. Dept., Univ. of Tenn., Knoxville
*Hurley, W. C., A & I College, Nashville
Hutton, C. A., Box 1071, Knoxville
Lush, R. H., Dairy Dept., Univ. of Tenn., Knoxville
Lusk, John W., Box 694, College Sta., Martin
Maddox, James N., Lewisburg Dairy Sta., Lewisburg
Moss, W. F., 4 Federal Bldg., Chattanooga
Naive, J. B., Beverly Hills Sanatorium, Knoxville
Overcast, Woodrow W., Dairy Ind. Dept., Univ. of Tenn., Knoxville
Parsons, V. D., Box 1071, Knoxville
Record, P. R., c/o Security Mills, Knoxville
Rogers, L. R., Lashbrooke Farms, Louisville

RUBIS, JOSEPH A., 608 Shady Lane, Nashville
SWANSON, ERIC W., Dairy Dept., Univ. of Tenn., Knoxville
WYLIE, C. E., Dairy Dept., Univ. of Tenn., Knoxville

Student Affiliates:

KLINKE, W. B. III, 2477 Summer Lane, Memphis
LANKFORD, M. P., Pet Milk Co., Greenville
SKINNER, C. R., 2925 Natches Lane, Memphis

TEXAS

Members:

BURNS, CHARLES F., Rt. 2, Sherman
*CARDWELL, JOE T., Dairy Manuf. Dept., Texas Tech. College, Lubbock
*CHAPMAN, WILLIAM E., Box 564, Wichita Falls
DARNELL, A. L., Texas A & M College, College Sta.
EISENSTEIN, PHILIP PIERCE, 2314 South Blvd., Dallas
FEATRO, JOSEPH G., Dairy Husb. Dept., A & M College of Texas, College Sta.
FINE, N. C., Animal Husb. Dept., Texas Tech. College, Lubbock
*FROEDGE, J. RALPH, Ft. Worth Poultry & Egg Co., Box 1537, Ft. Worth
GIBSON, G. G., Ext. Dairyman, College Sta.
HARMON, L. G., Dairy Manuf. Dept., Texas Tech. College, Lubbock
HEEP, HERMAN F., Heep Jersey Farms, Buda
HOMEYER, W. C., Arrow Mills Inc., Box 3012, Houston
JOHNSTON, J. B., 4236 Lovell Ave., Ft. Worth 7
KILGORE, J. P., c/o Eastland Creamery, Eastland
LEIGHTON, R. E., Dairy Dept., Texas A & M College, College Sta.
LIVELY, JACK, Bluff View Farm, North West Highway, Dallas
*LOVELESS, LUTHER, Box 275, Friona
MADDEN, FRED, 637 Hill St., Grand Prairie
METZGER, JACOB, Box 399, Dallas
MOORE, A. V., Dairy Dept., Texas A & M College, College Sta.
PEARSON, P. B., Nutr. Lab., A & M College, College Sta.
PEDERSON, M. G., c/o Prices Creameries, Inc., El Paso
PRICE, ROBERT B., Prices Creameries, Inc., Box 1572, El Paso
PRICHARD, ARTHUR, The Borden Co., Amarillo
REED, W. W., John Tarleton College, Stephenville
RICHARDS, HARVEY, L. JR., Hygeia Milk Co., Harlingen
ROBB, NOEL N., Prod. Mgr., Carnation Co., Box 914, Houston
ROMING, JOHN A., 2880 Burchill Rd., Ft. Worth 5
RUPEL, I. W., Dairy Husb. Dept., Texas A & M College, College Sta.
SHEPARDSON, C. N., Dairy Husb. Dept., Texas A & M College, College Sta.
TULLEY, W. C., Box 1688, Ft. Worth
WILLINGHAM, J. J., Mrs. Tucker's Foods, Inc., Sherman

Student Affiliates:

ANTHONY, W. B., Dairy Husb. Dept., A & M College, College Sta.
ASH, JOHN, 643 S.E. 8th, Grand Prairie
BESHEARS, WILLIAM G., 828 W. Gandy St., Denison
DIXON, JIM, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
GAITHER, FOY, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
HOGAN, DONALD, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
HOWELL, JAMES, c/o Kraft Foods Co., Denison
KENDALL, WILLIAM L., Box 627, College Sta.
KOLBERG, D. C., Box 96, Eagle Lake
LANHAM, W. G., 699 N. Evergreen, Memphis
LOVELADY, ROY, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
MAGEE, WILLIAM C., Route 2, Harlingen
MARSH, D. C., Dairy Husb. Dept., Texas A & M College, College Sta.
MAXEY, CHESTER, Dept. of Dairy Mfgs., Texas Tech. College, Lubbock
MCEWEN, EARL, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
MURRAY, H. G., Box 4646, College Sta.
NIEMEYER, E. V., Rt. 3, Brenham
PAYNE, JOHN, c/o Creamery Package Mfg. Co., Dallas
PEEPLES, MILTON, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
PLUMMER, WILLIAM H., Dairy Mfgs. Dept., Texas Tech. College, Lubbock
PRATHER, WILLIAM E., Box 2442, College Sta.
PRICE, C. R., Dairy Mfgs. Dept., Texas Tech. College, Lubbock
RAMSEL, W. B., Rt. 42, Box 1016, El Paso
SMITH, LOTT B., Dairy Mfgs. Dept., Texas Tech. College, Lubbock
SPROULS, HENRY, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
SUGAREK, RICHARD, c/o Creamery Package Mfg. Co., Houston
TERRY, J. S., c/o Meyer Blanke Co., Dallas
TOMLINSON, HORACE, Dairy Mfgs. Dept., Texas Tech. College, Lubbock
TUCKER, C. H., Box 5687, College Sta.
TURNBOW, HORACE, Rt. 5, Lubbock
TURNER, WOODROW, 830 W. Gandy, Denison
WALKER, JOHN H., 649 Robinson St., Apt. 2, Corpus Christi

UTAH

Members:

ANDERSON, H. D., Ephraim
BATEMAN, GEORGE Q., Utah State Agr. College, Logan
CAINE, GEORGE B., Utah State Agr. College, Logan
CURTIS, L. R., 2184 Oneida St., Salt Lake City 5
FERRIS, REED, 941 S. 13th E., Salt Lake City
HARDELL, ROBERT, 657 E. Center St., Logan
HOSKISSON, WILLIAM A., 952 Windsor St., Salt Lake City 4
LAMB, D. O., Box 2490, Salt Lake City 14
LARSEN, PAUL B., Dairy Husb, Dept., Utah State Agr. College, Logan
MORRIS, A. J., Dairy Husb. Dept., Utah State Agr. College, Logan
PARRISH, WALLACE A., 280 E. 5th N., Logan
QUALE, JOSEPH R., 375 N. 1st E., Logan
RICH, LYMAN A., Utah State Agr. Ext. Serv., Logan
WASSON, A. J., c/o Piedmont Dairy, Vernal
BROWN, EARL S., 716 E. 2nd N., Logan
BUSHMAN, KEITH H., 296 E. 4th N., Logan
CHURCH, WARREN H., La Verkin
CURTIS, JOHN K., 1115 S. 4th E., Salt Lake City
DAVIS, JESS H., 285 N. 3rd E., Logan
GODFREY, WILLIAM R., 493 E. 56th S., Murray
HILL, DANIEL E., 517 E. 5th N., Logan
HUNSKAER, LLOYD R., 57 S. 4th W., Logan
KNAPHUS, LLOYD M., c/o Clyde Biddulph, Route 1, N. Logan
MICHAELSEN, MYLES, Mayfield
MILLER, IVAN, College Housing 505, Logan
NAGMOUSH, MOUNIR R., 85 E. 5th N., Logan
PETERSON, SCOTT R., Peterson Bros., Holstein Farms, Box 922, Park City
SANDERS, DOAN C. JR., Farmington
STEVENS, RICHARD G., 84 G St., Salt Lake City
TAYLOR, HERBERT G., Richmond
VANDERBEEK, JAMES, 45 E. 5th N., Logan
WINDER, QUENTIN C., 2470 W. 3500 S., Salt Lake City

Student Affiliates:

ARMOND, MARAY H., Hyde Park

VERMONT

Members:

*BLANDING, L. W. R., Holstein-Friesian Assoc., Brattleboro
BRADFIELD, ALEX, 210 Loomis St., Burlington
BREMER, HARRY E., Dept. of Agr., State House, Montpelier
CAMBURN, O. M., 489 Main St., Burlington
CHAFFEE, L. L., Morrisville
CONKLIN, C. T., Ayrshire Breeders Assoc., Brandon
*DODGE, WARREN A., 489 Main St., Burlington
ELLENBERGER, H. B., Univ. of Vt., Burlington
FRAYER, JAMES M., Vt. Agr. Expt. Sta., 489 Main St., Burlington
HAMLEN, C. L., St. Albans
LOVELAND, E. H., Stowe
NEWCITY, GLADWYN, 16 Henry St., Bellow Falls
NEWLANDER, J. A., Univ. of Vt., Burlington
NORTON, H. W. JR., Holstein Friesian Assn. of America, Brattleboro
RIDDELL, W. H., Univ. of Vt., Burlington
STILES, ALBERT H., 32 Proctor Ave., S. Burlington
WARNER, WILLIAM K., 96 Colchester Ave., Burlington

Student Affiliates:

ATHERTON, HENRY V., 272 Colchester Ave., Burlington
HARVEY, SYLVESTER T., 14 Univ. Terrace, Burlington
RESI, LOUIS A., 55 S. Union St., Burlington
SYKES, JAMES C., 440 Pearl St., Burlington

VIRGINIA

Members:

ARRAMITH, JAMES F., Royal Dairy, Front Royal
BUSSEY, J. C., Southern Dairies, Rocky Mt.
CONNELLY, R. G., Dairy Dept., College of Agr., Blacksburg
EMERY, H. J., 1737 Queens Lane, Arlington
FLEMING, W. CLARK, Bayville Farm, Lynnhaven
FLORA, CARROLL C., Dairy Bldg., Va. Poly. Inst., Blacksburg
GRAFF, G. C., Va. Poly. Inst., Blacksburg
GREENBANK, GEORGE R., 632 24th St. S., Arlington
GREGG, V. L., Rt. 5, Box 249, Alexandria
HENDERSON, LATON M., Southern Dairies, Inc., Christiansburg
HERRMANN, LOUIS F., 3022 N. Westmoreland Dr., Falls Church
HOLDAWAY, C. W., Dairy Husb. Dept., Va. Poly. Inst., Blacksburg
HOPKINS, A. G., Airville Farm, Shackleford
JAMISON, W. P., Southern Dairies, Christiansburg
KENNEDY, G. S., Health Dept., City of Roanoke, Roanoke
MABE, Farmers' Creamery, Fredericksburg
MALLORY, T. E., Bland

MILLER, W. C., Garst Bros. Dairy, Roanoke
MOORE, JAMES D., Pet Milk Co., Abingdon
OMMODT, B. J., 2702 Valley Dr., Alexandria
*OWEN, JOHN W., State Milk Commission, 1203 E. Broad St., Richmond 19
POMEROY, C. J. JR., Cedar Spring Farm, Quinton
REAVES, P. M., Va. Poly. Inst., Blacksburg
RENNIE, FRANK F. JR., 1810 W. Main St., Richmond
*SMITH, S. S., 1003 State Office Bldg., Richmond
THOMPSON, NORMAN R., Agr. Expt. Sta., Blacksburg
TRELOGAN, HARRY C., 6025 N. 18th St., Arlington
WEAVER, G. ROY, Clover Creamery Co., Inc., Radford
WEIRETHER, FRANCIS J., Merck & Co., Inc., Elkton
WRIGHT, DEAN A., Ninovan Farms, Gordonville

Student Affiliates:

BROOKS, JAMES P., Dairy Husb. Dept., Va. Poly. Inst., Blacksburg
CHANCE, CHARLES, Dairy Husb. Dept., Va. Poly. Inst., Blacksburg
FAUNTLEROY, C. H. L., Dairy Husb. Dept., Va. Poly. Inst., Blacksburg
HALL, CHARLES JR., Dairy Husb. Dept., Va. Poly. Inst., Blacksburg
HALL, OAKLEY, 6919 Vanderbilt Ave., Richmond
PAIS, ALEXANDER A., Dairy Husb. Dept., Va. Poly. Inst., Blacksburg
ROLLINS, G. H., Va. Poly. Inst., Dairy Husb. Dept., Blacksburg
SHELAR, GLEN, Dairy Husb. Dept., Va. Poly. Inst., Blacksburg
STONE, JAMES W., Chilhowie

WASHINGTON

Members:

ANDREWS, GEORGE, 10227 15 N. E., Seattle 55
ASHWORTH, U. S., State College of Wash., Pullman
BECK, A. J., 1224 N. 45th St., Seattle 3
BENDIXEN, H. A., Dairy Husb. Dept., State College of Wash., Pullman
BERRY, M. H., Carnation Milk Farms, Carnation
BONEY, M. M., Box 157, Bellingham
BOWMAN, RALPH, 1727 N. Ledgerwood, Spokane 13
COWAN, ROBERT, 635 Elliott Ave. W., Seattle 99
DAHLBERG, A. O., 2500 W. Viewmont Way, Seattle 99
ELLINGTON, E. V., Dairy Dept., State College of Wash., Pullman
ERB, R. E., Dairy Husb. Dept., State College of Wash., Pullman
FORDHAM, WAYNE W., Route 4, Box 210, Kent
GAISER, J. L., Yakima Dairymen's Assoc., Yakima
GIBERSON, EBERT, 915 S. 3rd St., Apt. A, Tacoma 3
GOLDING, N. S., Dairy Husb. Dept., Wash. State College, Pullman
HALE, ROBERT E., 2035 Nielsen Ave., Enumclaw
HILL, OTTO J., Wash. Coop. Egg & Poultry Assn., 201 Elliott Ave. W., Seattle 99
JANZEN, HAROLD W., Box 391, Vancouver
KNOTT, J. C., Dairy Dept., State College of Wash., Pullman
LARSON, HAROLD, 3823 S. Wilkeson St., Tacoma 8
LUNDQUIST, NORMAN S., Dairy Husb. Dept., State College of Wash., Pullman
*MANUS, LOUIS J., 328 Moscow Rd., Pullman
MOORE, GEORGE R., Rt. 2, Walla Walla
NICHOLS, M. B., Agr. Ext. Serv., State College of Wash., Pullman
PALMER, W. HORACE, Box 250, Steilacoom
PHILLIPS, J. E., Box 22, Spokane
PROUTY, C. C., Wash. Agr. Expt. Sta., Pullman
RUSSELL, JAMES, Kitsap Dairymens Assn., Box 314, Bremerton
SHAW, A. O., Dairy Husb. Dept., State College of Wash., Pullman
SORENSEN, ERNEST M., Box 389, Chehalis
SWEETING, BERT, Medosweet Dairies, Tacoma
USTLER, GEORGE H., Angeles Coop. Creamery, Port Angeles
WALDO, D. R., Mt. Vernon

Student Affiliates:

BLINDHEIM, ALVIN, 1203 Maple St., Pullman
CHRISTENSEN, LAWRENCE J., 1301 Kamiaken, Pullman
CROUSE, WILLIAM, 704 Campus Ave., Pullman
DELANEY, ERNEST, Rt. 2, Box 142 A, Clarkston
DURGAN, WILLIAM, Dean, Columbia House A, Pullman
GOHEEN, ROBERT L., Rt. 3, Box 679, Bellingham
GRIMM, JOHN, 43 C. S. Fairway Apts., Pullman
GUSTAFSON, CLAYTON R., Gen. Delivery, Tsaguah
HIBBS, R. A., Box 758, College Sta., Pullman
KRUEGER, GORDON J., Dairy Husb. Dept., State College of Wash., Pullman
LARSON, JAMES ERIC, c/o W. H. Latta, Rt. 1, Pullman
NOWADNICK, RICHARD, Rt. 3, Box 32, Chehalis

SCOTT, G. W., Dairy Husb. Dept., State College of Wash., Pullman

THOMAS, ROSS G., 10 A, South Fairway, Pullman

WEST VIRGINIA

Members:

BOWMAN, A. W., Coble Dairy Prod., Martinsburg
BRUYNEEL, A. L., 620 Gaston Ave., Fairmont
HEEBINK, GERALD, W. Va. Dairymens Assn., Oglebay Hall, Morgantown
HENDERSEN, H. O., College of Agr., Morgantown
HOUSER, LEROY, The Borden Co., 8th Ave. & 12th St., Huntington
HUTCHINSON, HUGH F., Box 351, Lewisburg
HYATT, GEORGE JR., Dairy Dept., W. Va. Univ., Morgantown
MCCULLOUGH, MARSHALL E., Wick
PINSKY, HARRY, 57 17th St., Wheeling
PORTER, CLYDE C., Lesage
PRATT, AVERY D., 816 College Ave., Bluefield
REEVES, CHARLES V., 54 Monroe St., Elm Grove, Wheeling
TYLER, WILBUR J., Dairy Husb. Dept., W. Va. Univ., Morgantown
VAN LANDINGHAM, A. H., Agr. Expt. Sta., Morgantown
WEESE, SAMUEL J., 227 Hagans Ave., Morgantown

Student Affiliates:

HARDESTY, JAMES S., 420 Morgan St., Morgantown
HARTLEY, RICHARD, 1438 Hildreth Ave., Wheeling
JOHNSTON, WILLIAM P., 150 Newton St., Morgantown
PARRISH, EUGENE M., 408 McLane Ave., Morgantown
PRICE, LLOYD M., 122 14th St., Wheeling

WISCONSIN

Members:

ALLEN, NAT N., Dairy Husb. Dept., Univ. of Wis., Madison 6
ALTON, ALVIN J., Taylor Freezer, Beloit
ANDERSON, OLIN, Consolidated Badger Coop., Shawano
BARRETT, GEORGE R., R.R. 1, Middleton
BERNDT, FRITZ R., 326 4th St., Prairie du Sac
BOEING, D. P., 208 Wilson Ave., Menomonie
BOHSTEDT, GUS, College of Agr., Madison
BRACE, CHARLES C., Lone Rock
BRADLEY, FRANKLIN, Rt. 4, Edgerton
BROWN, L. W., Dairy & Food Control Lab., Univ. of Wis., Madison 6
BUSH, M. G., Box 23, Green Bay
CALL, A. O., Western Condensing Co., Appleton
CARLSON, JOHN A., 515 N. Clark St., Appleton
CHRISLER, EARL S., 620 N. 8th St., Milwaukee 3
CRAMER, A. J., 1642 Monroe St., Madison 5
DREHER, W. H., Badger Breeder's Coop., Shawano
DUGDALE, B. R., 4150 Hiawatha Dr., Madison 5
ELDER, H. K., 801 E. College Ave., Waukesha
ELLERTON, MELVIN E., 2119 E. Woodstock Pl., Milwaukee 2
EREKSON, ARTHUR B., Lakeshire-Marty Co., Plymouth
FABRICIUS, N. E., Ladysmith Milk Prod. Coop. Assn., Box 167, Ladysmith
FARNHAM, MERLE G., Box 192, R. R. 14, Milwaukee 13
FLOTZ, FRED, Lakeshire-Marty Co., Monroe
FORSTER, T. L., Dairy Ind. Dept., Univ. of Wis., Madison
FRAZIER, WM. C., College of Agric., Univ. of Wis., Madison 6
GEORGE, A. D., Maple Leaf Dairies, Inc., Neenah
GOULD, GEORGE B., Outagamie Prod. Coop., Black Creek
HALADA, JEROME A., 306 S. Falls St., River Falls
HALES, M. W., Chr. Hansen's Lab., Inc., 9015 W. Maple St., Milwaukee 14
HALL, SUMNER A., c/o A & P Tea Co., Box 859, Sta. A, Green Bay
HANSEN, GLEN, 1252 S. Forwell, Eau Claire
HARDING, H. A., Baileys Harbor
HARRIS, ROY T., Dairy Records Office, 207 King Hall, Madison 6
HART, E. B., Biochemistry Dept., Univ. of Wis., Madison
HARTMAN, G. H., 2114 Fairmont St., Manitowoc
HASKELL, W. H., Klenzade Prod., Inc., Box 70, Beloit
HEISER, GEORGE JR., 1609 E. North Ave., Milwaukee 2
HEIZER, EDWIN E., Dairy Husb. Dept., Univ. of Wis., Madison
IRELAND, WM. R., Prog. Dairy Prod. Co., 1214 Lathrop Ave., Racine
JACKSON, H. C., Dairy Dept., Univ. of Wis., Madison
JOHNSEN, S. H., The Borden Co., Waukesha
JORDAN, W. G., The Borden Co., Waukesha
KASLER, GALE R., 620 N. Eighth St., Milwaukee 3
KELLER, LESLIE G., Kewaskum Creamery Co., Kewaskum
KLUETER, HARRY, Room 706, 1 W. Main, Madison
KNOX, WILLIAM D., c/o Hoard's Dairyman, Ft. Atkinson

KOCH, HARLAN R., 4346 Hillcrest Dr., Madison 5
KRAUSE, F. W., Meier Ice Cream Co., Waukesha
LARSON, RUSSELL HERBERT, Rt. 1, c/o Carl Messer, Beaver Dam
LEGRID, LESTER I., Dairy Div., Wis. State Dept. of Agr., State Capital, Madison
LERNER, LOUIS L., C-Z Box, Beloit
MELHUISH, VERN P., 628 S. St., Oconomowoc
*MEYER, EUGENE C., Assoc. Editor, Hoard's Dairyman, Ft. Atkinson
MILLER, PAUL G., Carnation Co., Research Lab., Oconomowoc
NUSBAUM, DAVE, c/o L. D. Schreiber Co., 1805 Main St., Green Bay
OBERG, E. B., 2344 N. Oakland Ave., Milwaukee
O'DONNELL, E. J., Klenzade Prod., Inc., Box 70, Beloit
OLSEN, L. S., OLSEN PUBLISHING CO., 1445 N. 5th St. at W. Cherry, Milwaukee 12
PRICE, W. V., Hiram Smith Hall, Univ. of Wis., Madison 6
PRENTICE, J. ROCKEFELLER, Lake Geneva
*PROCHEP, ARNOLD J., 4129 A North 42nd St., Milwaukee 9
PHILLIPS, PAUL H., Dept. of Biochem., Univ. of Wis., Madison
POPE, S. M., c/o Shefford Cheese Co., Green Bay
PULKRABEK, G. M., Kraft Foods Co., Plymouth
RYDZEWSKI, GEORGE S., 1605 S. 37th St., Milwaukee
SCHMIT, RAY, 2206 N. 30th St., Milwaukee
SCOTT, H. T., Wis. Alumni Research Foundation, Madison
SHOGREN, C. B., Klenzade Prod. Inc., Beloit
SLEMMONS, WILBERT S., Carnation Co., Oconomowoc
SLETTEN, GEORGE R., 340 W. Wisconsin Ave., Oconomowoc
SMITH, VEARL, Dairy Husb. Dept., Univ. of Wis., Madison
SNELL, CARL H., 903 N. Wilson Ave., Rice Lake
SNYDER, WALTER E., Carnation Co., Research Labs., Oconomowoc
SOMMER, H. H., Dairy Husb. Dept., Univ. of Wis., Madison 6
SPITZER, ROBERT R., Murphy Prod. Co., Burlington
SPRAGUE, GORDON W., Box 902, Appleton
SPURGEON, KENNETH R., Dairy Ind. Dept., Univ. of Wis., Madison 6
STALLARD, J. E., 207 King Hall, Univ. of Wis., Madison 6
STECKELBERG, FRED, Dairy Ind. Dept., Univ. of Wis., Madison
STEIN, BRUNO, Shorewood Hills, Madison
STICHA, A. J., 113 W. Lakeside St., Madison 5
SWANSON, ARTHUR M., Dairy Ind. Dept., Univ. of Wis., Madison
TARKOW, LEONARD, 427 W. National Ave., Milwaukee 4
THEW, HARVEY E., 29 Coyne Ct., Madison Milk Prod. Assn., Madison
THOMAS, HUGH, 2525 Major Ave., Madison 4
THOMSEN, L. C., 3414 Viburnum Dr., Shorewood Hills, Madison 5
THOMPSON, DONALD I., Bloomer
TOOBY, GEORGE, Box D, River Falls
TREBILCOCK, ROY J., 1539 Alice St., Wauwatosa
TRISH, KARL A., 7722 6th Ave., Kenosha
USELMAN, W., Galoway-West Co., Fond du Lac
VERGERONT, GLEN W., 207 King Hall, College of Agr., Madison
WALLENFELDT, E., Dairy Ind. Dept., Univ. of Wis., Madison 6
WEBER, HIRAM R., 136 Fifth Ave., Antigo
WECKEL, KENNETH G., Dairy Ind. Dept., Univ. of Wis., Madison 6
WEIBEL, WILLIAM B., Ellsworth Creamery, Ellsworth
WERNER, GEORGE M., Dairy Husb. Dept., College of Agr., Madison
WIESNER, M. W., c/o Western Condensing Co., Ripon
WILKE, THEODORE M., 3167 N. Booth St., Milwaukee 12
WILLARD, ESTHER M., 330 Goldsmith Bldg., Milwaukee 2
WILLETT, E. L., American Scientific Breeding Inst., R.F.D. 1, Madison
WISE, WESLEY, Kiel
ZIMMERMAN, PAUL L., c/o Marathon Corp., Research Lab., Menasha

Student Affiliates:

ADAMS, HOLYOKE P., Dairy Husb. Dept., Univ. of Wis., Madison
ALFORD, JOHN A., Ag. Bact. Dept., Univ. of Wis., Madison
ANDERSEON, ROBERT T., 919 Spaight St., Madison 3
AYTAC, MEHMET, 231 W. Getman, Madison 3
BAYLEY, NED D., Dairy Husb. Dept., Univ. of Wis., Madison 6
BERG, LESLIE R., Dairy Ind. Dept., Univ. of Wis., Madison
BLOSSER, T. H., Dairy Husb. Dept., Univ. of Wis., Madison
BUSS, FRANK J., Caroline
CALBERT, HAROLD E., 202 Hiram Smith Hall, Univ. of Wis., Madison 6
CROWLEY, JAMES W., Dairy Husb. Dept., Univ. of Wis., Madison
DRAKE, GLEN C., 1046 E. Gorham, Madison
EBERT, HARVEY H., Westfield
EDGE, TOM B., Fennimore
GOLDMAN, SPENCER, 911 W. Dayton St., Madison
HAGBERG, ELROY C., Dairy Ind. Dept., Univ. of Wis., Madison
HARPER, JAMES W., Dairy Ind. Dept., Univ. of Wis., Madison

HELDKE, R. E., 34 Highland St., Rice Lake
HOLLENDER, HERBERT A., Dairy Ind. Dept., Univ. of Wis., Madison
HUSTON, KEITH, Dairy Husb. Dept., Univ. of Wis., Madison
IRVINE, D. M., Dairy Ind. Dept., Univ. of Wis., Madison
JAFAR, SYED M., Dept. of Gen., Univ. of Wis., Madison
JIRIKOVEC, L. E., 127 W. Gilman St., Madison
JOHNSON, DALE W., 514 Third Ave., Antigo
JOHNSON, RALPH V., c/o Luick Dairy Co., 1132 N. 6th St., Milwaukee
KARAM, HASSAN A., Dept. of Gen., Univ. of Wis., Madison
KAUTZ, HERMAN G., 305 Midvale Blvd., Madison
KIRSCH, L. E., Kraft Foods Co., Monroe
KURTZWEIL, ROBERT R., 237 Waugoo St., Oshkosh
LINDEN, HAROLD K., Box 538, Badger
LOVELL, ROBERT B., 319 Lucile St., Ft. Atkinson
MADSEN, CARL, 1756 E. Mason, Green Bay
MAXCY, RUTHERFORD B., Dairy Ind. Dept., Univ. of Wis., Madison
MEYER, DALE D., 722 E. Johnson St., Madison
NIEDERMEIER, R. P., Dairy Husb. Dept., Univ. of Wis., Madison 6
PETERSON, JOSEPH F., 1109 W. Dayton St., Madison
PRICE, ROBERT B. JR., 213 N. Randall Ave., Madison
RANKIN, STEPHEN W., 442 N. Main St., Mayville
ROEDER, HAROLD, Route 1, Elkhart Lake
ROSSINI, DARIO D., 432 N. Lake St., Madison
SCHLICT, WALTER C., 1512 Hyde Ave., La Crosse
SCHULTZ, LORIS H., Dairy Husb. Dept., Univ. of Wis., Madison
SHAHANI, KHEM M., Dairy Ind. Dept., Univ. of Wis., Madison
STODDARD, GEORGE E., Dairy Husb. Dept., Univ. of Wis., Madison
STONE, EDWARD L., Box 97, Frederic
TORO, EMILIO DEL, Dairy Husb. Dept., Univ. of Wis., Madison
TRIVEDY, JAI NARAIN, Dairy Husb. Dept., Univ. of Wis., Madison
WINDER, WILLIAM C., 232 Midvale Blvd., Madison 5
WOOD, CALVIN, 1632 Jefferson St., Madison
ZANDER, GERALD W., Cross Plains

WYOMING

Members:

CARTER, HUGH C., Laramie Valley Creamery, 166 N. 3rd St., Laramie
*ENGENDORFF, O. H., Dept. of Agr., Box 17, Worland
*IIAMS, RAY E., 51 Bellvue Ave., Sheridan

Student Affiliates:

DODSON, THEODORE T. JR., c/o Gen. Delivery, Cody

AUTHOR INDEX OF ORIGINAL ARTICLES

ACKERMAN, R. A., prepartum milking and colostrum composition, 685*

ADAMS, H. P., oxytocin for reducing production fluctuations, 622*

ALLEN, N. N., udder clipping and quality of milk, 323; oxytocin for reducing production fluctuations, 662*; permanent rumen fistula, 668*

ALLEN, R. S., effect of soybeans on plasma carotene and vitamin A, 421; feeding soybean products, 664*; carotene and vitamin A absorption, 671*

ALMQUIST, J. O., effect of penicillin upon bovine semen, 11; streptomycin treatment for bovine semen, 501; staining bovine spermatozoa, 677*; penicillin and semen fertility, 681*; agitation and livability of spermatoza, 839

AMERICAN DAIRY SCIENCE ASSOCIATION, call for papers, 89; officers and committees, 90; program of 43rd annual meeting, 389

ANDERSON, E. O., leucocyte content of milk, 723*; judging dairy products, 823

ANDERSON, H. W., semen dilution and cooling, 551

ARBUCKLE, W. S., stabilizers and emulsifiers in ice cream, 703*

ARRINGTON, L. R., feeding dairy calves remade skim milk, 1; refractometer readings for watered milk, 717*

ASHWORTH, U. S., keeping quality of powdered whole milk, 517; solubility and density of powdered whole milk, 935

ATKESON, F. W., nitrogenous constituents of colostrum, 889

BABCOCK, C. J., keeping quality of frozen homogenized milk after thawing, 805; the keeping quality of frozen homogenized milk, 811; judging dairy products, 823

BABEL, F. J., ultraviolet irradiation of bacteriophage, 509; bacteriophage production by *Streptococcus lactis*, 708*

BAKER, R. J., added amino acids and Cheddar cheese flavor, 715*

BARKI, V. H., nutritive value of butterfat fractions, 793

BARRETT, G. R., breeding efficiency measurement, 682*; insemination order number and conception rate, 683*

BARTLETT, J. W., multiple births in a Holstein-Friesian herd, 241

BELL, R. W., oxidized flavor in frozen milk, 720*; oxidized flavor of frozen milk, 951

BLANTON, L. F., stabilizers and emulsifiers in ice cream, 703*

BLOSSER, T. H., citric acid levels in bovine blood and urine, 683*

BOLIN, D. W., blood vitamin A activity, 664*

BOLIN, F. M., blood vitamin A activity, 664*

BORTREE, A. L., treatment of milking machine inflations, 331

BRANTON, C., bulls fed rations low in carotene, 779

BRATTON, R. W., bulls fed rations low in carotene, 779; sulfanilamide in bull semen, 817

BRODY, SAMUEL, cardiorespiratory activities and heat production, 666*

BURKHART, ROBERT L., sulfamethazine blood and milk concentrations, 103

CALBERT, HAROLD E., diacetyl in Cheddar cheese, 713*

CAMBURN, O. M., comparison of sun and barn-cured hays, 691*

CANNON, C. Y., effect of soybeans on plasma carotene and vitamin A, 421; feeding soybean products, 664*

CARNEIRO, GERALDO G., milk yield under pen-keeping system in Brazil, 203

CARPENTER, MARSHALL, evaluation of bull semen, 677*

CARPENTER, R. A., insemination order number and conception rate, 683*

CARR, P. H., electron microscope studies of *S. lactis* bacteriophage, 709*

CASIDA, L. E., breeding efficiency measurement, 682*

CHOI, R. P., water of crystallization of α-lactose, 619; α- and ß-lactose in dry milk products, 701*

CLAYDON, T. J., grading farm-separated cream, 577; skunk-like odor in cream, 725*

COHENOUR, FRANCIS D., acid production by cheese cultures, 709*

* Abstracts of papers presented at Annual Meeting of the American Dairy Science Association.

COLE, H. H., the bloat problem, 668*; ruminal gas formation, 1016
COLLINS, E. B., bacteria and soluble nitrogen in milk, 726*
COLVARD, CHARLES D., H.T.S.T. pasteurization of chocolate milk, 707*
COOPER, A. W., mow curing of baled hay, 687*
COULTER, S. T., measuring fluorescent materials in milk, 367; reducing capacity of milk, 595; heat treatment and reducing systems of milk, 699*; storage changes in dry whole milk, 986
CROWE, L. K., reducing capacity of milk, 595; storage changes in dry whole milk, 986

DAHLBERG, A. C., *S. faecalis* starter for Cheddar cheese, 275; growth and survival of *S. faecalis* in Cheddar cheese, 285; tyramine content of cheese, 293; effect of tyramine and *S. faecalis* on flavor of Cheddar cheese, 305; phosphatase test for cheese, 561; cheese pasteurization by radio-frequency heat, 710*; ripening temperature and tyramine in Cheddar cheese, 714*
DAVIS, H. P., thyroxine treatment of bovine semen, 682*; thyroxine and bovine spermatozoa, 946
DAVIS, R. N., lactating factor in dried grapefruit peel, 691*, 973
DEYSHER, E. F., crystalline deposit in evaporated milk, 123
DOWNS, P. A., judging dairy products, 823
DUNCAN, C. W., carbohydrate comparisons in synthetic rations for calves, 674*

EATON, H. D., estimating feed from pasture, 353; prepartum vitamin A supplementation, 669*; fetal liver stores of vitamin A, 670*; prepartum milking and colostrum composition, 685*; composition of first colostrum, 686*; prepartum milking and blood constituents, 684*
EDMONDSON, J. E., bacteria in bovine semen, 681*
EHEART, JAMES F., feeding dehydrated sweet potatoes, 569
ELLIKER, P. R., nonfat dry-milk solids in Cheddar cheese manufacture, 712*; hypochlorites and quaternary ammonium compounds as plant germicides, 724*
ELLMORE, M. F., soybeans and vitamin A requirements, 665*
EL-RAFEY, M. S., milk lipids and the foaming of milk, 223
ELVEHJEM, C. A., nutritive value of butterfat fractions, 793
ESH, G. C., changes in tryptophan content of calf blood plasma, 183; soya-phosphatides and vitamin A, 461; dietary tryptophan and niacin excretion, 675*, 909
ESPE, DWIGHT, blood vitamin A activity, 664
EVANS, LARUE B., keeping quality of frozen homogenized milk after thawing, 805; keeping quality of frozen homogenized milk, 811
EWING, J. A., early- and late-cut lespedeza hay, 690*; irrigated pastures, 696*

FAIRBANKS, B. W., water of crystallization of α-lactose, 619; α- and ß-lactose in dry milk products, 701*
FISCHER, JESSIE E., physiological effects of dietary lactose, 716*
FITCH, J. B., tocopherol feeding, 557
FLIPSE, R. J., carbohydrate comparisons in synthetic rations for calves, 674*
FOOTE, R. H., livability of spermatozoa, 763; sulfonamides and livability of spermatozoa, 769
FOUTS, E. L., refractometer readings for watered milk, 717*
FRANCIS, J., closure seepage with homogenized milk, 722*
FRAZEE, VIRGINIA, direct microscopic method for pasteurized milk, 708*
FRICK, G. E., estimating feed from pasture, 353
FRITZ, J. S., butterfat test for ice cream, 905
FRYE, JENNINGS B., JR., sweet potatoes in ration of dairy cows, 341; winter pasture and sweet potato meal, 897

GAINES, W. L., liveweight and milk-energy yield, 119
GAMMON, NATHAN, JR., flame photometry for milk minerals, 717*
GARDNER, K. E., summer feeding of thyroprotein, 660*
GEARHART, C. R., dairy records committee report, 727*; revision of DHIA rules, 729*
GEHRKE, CHARLES W., biochemical activity of lactic culture bacteria grown in cow's and soybean milk, 213
GILMORE, L. O., tocopherol feeding, 557; sacral deformity in cattle, 797

GLANTZ, P. J., streptomycin treatment for bovine semen, 501
GREENBANK, GEORGE R., ascorbic acid and keeping quality of dried milk, 698*; antioxidant formation by processing, 698*; lipolysis prevention by heat treatment, 700*; review on oxidized flavor in milk, 913
GREENE, G. I., ultraviolet irradiation of bacteriophage, 509
GUERRANT, N. B., utilization of various forms of vitamin A, 111
GULLICKSON, T. W., tocopherol feeding, 557
GUTHRIE, E. S., freezing and fat oxidation, 721*; vitamin C and oxidation in homogenized milk, 722*; stability of milk fat and fat-soluble vitamins, 961

HAGBERG, E. C., casein separation and fractionation, 718*
HALVERSON, A. W., carotene preservation in feeds, 1008
HANSEN, R. G., blood calcium at parturition, 173
HARLAND, HERBERT, heat treatment and reducing systems of milk, 699*
HARPER, W. J., chemical methods of studying Cheddar cheese ripening, 714*; amino acids in ripening Cheddar cheese, 715*
HART, E. B., nutritive value of butterfat fractions, 793; carotene preservation in feeds, 1008
HATZIOLOS, B. C., soybeans and vitamin A requirements, 665*; biochemistry and histopathology of bovine ketosis, 667*
HAUGE, S. M., mow curing of baled hay, 687*
HAWKINS, GEORGE E., JR., winter pasture and sweet potato meal, 897
HENDERSON, HERBERT B., sweet potatoes in ration of dairy cows, 341; winter pasture and sweet potato meal, 897
HERMAN, H. A., spermatozoa behavior in bovine cervical mucus, 679*; bacteria in bovine semen, 681*; maximum roughage for heifers, 691*
HERREID, E. O., nordihydroguaiaretic acid as an antioxidant, 449; closure seepage with homogenized milk, 722*; nordihydroguaiaretic acid in unsweetened frozen cream, 1024
HERRINGTON, B. L., cheese pasteurization by radio-frequency heat, 710*
HERZER, F. H., judging dairy products, 823
HETRICK, J. H., phosphatase inactivation, 706*, direct nesslerization of digested milk, 718*; gas from whole milk powder, 831; H.T.S.T. inactivation of phosphatase, 867; H.T.S.T. inactivation of lipase, 881
HIBBS, J. W., soya-phosphatides and vitamin A, 461; ration and blood vitamin changes, 672*; microorganisms in digestive tract of calves, 672*; influence of calf ration on rumen microorganisms, 1051; microorganisms in the calf rumen, 1041; rumen development and plasma composition, 1055
HIBBS, ROBERT A., water minerals and properties of ice cream mixes, 703*
HINTON, S. A., calf raising without colostrum, 674*; wintering heifers on legume hay, 692*; silage vs. winter pasture, 695*
HIRD, E. B., udder clipping and quality of milk, 323
HOCKBERG, MELVIN, determination of vitamin A in milk, 315
HODGSON, R. E., renovation of pastures, 697*
HOLLENDER, H. A., method for free fatty acids in dairy products, 719*
HOLM, GEORGE E., linoleic acid in butterfat, 720*
HOLMES, ARTHUR D., ascorbic acid added to milk, 99
HORTON, OTIS H., spermatozoa behavior in bovine cervical mucus, 679*
HOSTERMAN, W. H., alfalfa preservation, 688*
HUFFMAN, C. F., carbohydrate comparisons in synthetic rations for calves, 674*
HUFNAGEL, C. F., storage and viscosity of sweetened condensed milk, 21; viscosity and heat stability of concentrated milks, 701*
HUGHES, J. S., form of vitamin A and tocopherol supplements, 686*; nitrogenous constituents of colostrum, 889
HURST, VICTOR, thyroid secretion rate, 659*
HUSSONG, R. V., *Oospora lactis* and ripening of Cheddar cheese, 713*; mechanical can washing, 724*
HYATT, GEORGE, JR., heritability of Ayrshire type ratings, 63; variations in Ayrshire cow type ratings, 71; prediction of butterfat production, 657*; age and type rating of Ayrshires, 663*; prepartum milking and colostrum composition, 685*

IRVINE, D. M., efficiency in Cheddar cheese manufacture, 711*

JACK, E. L., the browning reaction in milk powder and ice cream mix powder, 255;

milk fat fractionation by molecular distillation, 719*
JACOBSON, N. L., carotene and vitamin A absorption, 671*
JACOBSON, W. C., antirachitic value of hays, 489; spinal fluid pressure method for carotene requirements, 533; fluctuation of blood plasma vitamin A, 671*; iron alleviation of calf anemia, 676*
JENNESS, ROBERT, measuring fluorescent materials in milk, 367; reducing capacity of milk, 595; heat treatment and reducing systems of milk, 699*; storage changes in dry whole milk, 986
JENSEN, J. M., treatment of milking machine inflations, 331
JOHNSON, C. E., nonfat dry milk solids in Cheddar cheese manufacture, 712*
JOHNSON, MARVIN J., determination of cheese lipase, 31; lipase activity in Cheddar cheese, 39; determination of cheese proteinase, 47; proteinase content of Cheddar cheese, 55
JOHNSON, R. E., long-time calf losses, 669*; fetal liver stores of vitamin A, 670*; aerobic bacteria and feces consistency, 673*; prepartum milking and blood constituents, 684*; prepartum milking and colostrum composition, 685*; composition of first colostrum, 686*
JOHNSTON, JAMES E., hyaluronidase assay in bull semen, 678*; hyaluronidase in bull semen, 678*
JONES, CARLETON P., ascorbic acid added to milk, 99
JONES, I. R., month of calving and butterfat production, 1029
JOSEPHSON, DONALD V., heat-induced flavor compounds, 707*
JUNGHERR, E. L., long-time calf losses, 669*

KAESER, H. E., colostrum feeding, 523
KEMMERER, A. R., lactating factor in dried grapefruit peel, 691*, 973
KENDALL, K. A., stack finishing of baled hay, 688*; sweet sudan grass forage, 695*
KESLER, E. M., hypochlorite and quaternary ammonium compounds as udder washes, 179; bacterial flora of udders, 667*
KIBLER, H. H., cardiorespiratory activities and heat production, 666*
KING, W. A., mow curing of baled hay, 687*
KLEIBER, MAX, the bloat problem, 668*; ruminal gas formation, 1016
KNODT, C. B., effect of penicillin upon bovine semen, 11; mammary development and body weight, 95; utilization of various forms of vitamin A, 111; hypochlorite and quaternary ammonium compounds as udder washes, 179; feeding thyroprotein, 660*; bacterial flora of udders, 667*; supplemental vitamin A for heifers, 1062
KNOOP, C. E., let-down of milk, 694*
KOSIKOWSKY, F. V., *S. faecalis* starter for Cheddar cheese, 275; growth and survival of *S. faecalis* in Cheddar cheese, 285; tyramine content of cheese, 293; effect of tyramine and *S. faecalis* on flavor of Cheddar cheese, 305; phosphatase test for cheese, 561; cheese pasteurization by radio-frequency heat, 710*; ripening temperature and tyramine in Cheddar cheese, 714*
KRAUSS, W. E., soya-phosphatides and vitamin A, 461
KRIENKE, W. A., water minerals and properties of ice cream mixes, 703*; flame photometry for milk minerals, 717*
KRUKOVSKY, V. N., covitamin studies of milk fats, 666*; milk characteristics as influenced by hays, 690*; freezing and fat oxidation, 721*; ascorbic acid oxidation in milk by H_2O_2, 721*; vitamin C and oxidation in homogenized milk, 722*; stability of milk fat and fat-soluble vitamins, 961
KUMARAN, J. D. SAMPATH, hormones and spermatogenesis, 663*

LANGER, PETER H., sulfamethazine blood and milk concentrations, 103
LINKOUS, WOODROW N., feeding dehydrated sweet potatoes, 569
LOCHRY, H. R., lactobacilli and streptococci in Cheddar cheese, 716*
LOFGREEN, G. P., milk characteristics as influenced by hays, 690*
LLOYD, C. A., breeding efficiency measurement, 682*; insemination order number and conception rate, 683*
LOOSLI, J. K., tocopherols and fat content of milk, 665*; prepartum vitamin A supplementation, 669*; milk characteristics as influenced by hays, 690*; bulls fed rations low in carotene, 779
LUDWICK, T. M., evaluation of bull semen, 677*
LUSH, JAY L., milk yield under penkeeping system in Brazil, 203
LUSH, R. H., pastures in the South, 696*

MADDUX, J. M., early- and late-cut lespedeza hay, 690*
MADDUX, N., irrigated pastures, 696*
MANUS, LOUIS J., keeping quality of powdered whole milk, 517; solubility and density of powdered whole milk, 935
MATHER, ROBERT E., feeding dehydrated sweet potatoes, 569; genetic variation in plasma composition, 658*
MATTERSON, L. D., fetal liver stores of vitamin A, 670*; prepartum milking and blood constituents, 684*; prepartum milking and colostrum composition, 685*; composition of first colostrum, 686*
MEAD, S. W., crossing inbred Holsteins, 657*
MELIN, C. G., antirachitic value of hays, 489; alfalfa preservation, 688*; renovation of pastures, 697*
MERCIER, E., bulls fed rations low in carotene, 779
MILES, J. T., calf raising without colostrum, 674*; wintering heifers on legume hay, 692*
MILLEN, T. W., summer feeding of thyroprotein, 660*
MILLER, G. D., water sprinkling of cows, 361; summer cooling of cows, 693*
MILLER, P. G., volatile acidity of evaporated milk, 189
MIXNER, JOHN P., hyaluronidase assay in bull semen, 678*; hyaluronidase in bull semen, 678*
MONROE, C. F., winter pasture and milk carotenoids, 697*
MOORE, L. A., antirachitic value of hays, 489; fluid pressure method for carotene requirements, 533; thyroprotein feeding in successive lactations, 661*; soybeans and vitamin A requirements, 665*; iron alleviation of calf anemia, 676*; testis biopsy and semen characteristics, 679*; vitamin D and curing procedure, 689*
MUELLER, W. S., quaternary salts as influenced by water constituents, 723*
MUSGRAVE, S. D., liveweight and milk-energy yield, 119
MYKLEBY, RAY W., sediment tests for cream, 725*

NADEN, RALPH, mannitol of beef fat in ice cream, 704*
NATH, H., nutritive value of butterfat fractions, 793
NEEL, L. R., silage vs. winter pasture, 695*
NEITZKE, CARL, interdepartmental cooperation in dairy extension, 728*
NELSON, F. E., blue cheese from pasteurized milk, 611; microbial keeping quality of bulk condensed milk, 702*; electron microscope studies of *S. lactis* bacteriophage, 709*; added amino acids and Cheddar cheese flavor, 715*; coliform bacteria in butter, 726*; bacteria and soluble nitrogen in milk, 726*
NELSON, VICTOR, spectrophotometric determination of milk color, 409; color of evaporated milk, 415
NELSON, W. O., *Oospora lactis* and ripening of Cheddar cheese, 713*
NEVENS, W. B., stack finishing of baled hay, 688*; sweet sudan grass forage, 695*
NEWLANDER, J. A., vitamin D content of roughages, 455
NIEDERMEIER, R. P., blood calcium at parturition, 173; effect of udder inflation, 683*; non-milking after parturition and blood constituents, 684*

OBERG, E. B., volatile acidity of evaporated milk, 189
OLDS, D., evaluation of bull semen, 677*
OLOUFA, MOHAMED M., month of calving and butterfat production, 1029
O'MALLEY, C. M., water of crystallization of α-lactose, 619
OLSEN, L. B. (MRS.), milk fat fractionation by molecular distillation, 719*
OLSON, H. C., acid production by cheese cultures, 709*

PARMELEE, C. E., electron microscope studies of *S. lactis* bacteriophage, 709*
PARRISH, D. B., form of vitamin A and tocopherol supplements, 686*; nitrogenous constituents of colostrum, 889
PATRICK, HOMER, calf raising without colostrum, 674*
PATTON, STUART, heat-induced flavor compounds, 707*
PEARSON, A. M., microbial keeping quality of bulk condensed milk, 702*
PETERS, I. I., blue cheese from pasteurized milk, 611
PETERSEN, W. E., preparation and rate of milking, 589

PETERSON, MERLIN H., determination of cheese lipase, 31; lipase activity in Cheddar cheese, 39; determination of cheese proteinese, 47; proteinase content of Cheddar cheese, 55
PFAU, K. O., multiple births in a Holstein-Freisian herd, 241
PLASTRIDGE, W. N., long-time calf losses, 669*; aerobic bacteria and feces consistency, 673*
PORTERFIELD, RALPH, selecting 4-H calves, 728*
POUNDEN, W. D., ration and blood plasma vitamin changes, 672*; microorganisms in digestive tract of calves, 672*; influence of calf ration on rumen microorganisms, 1051; microorganisms in the calf rumen, 1041; rumen development and plasma composition, 1055
PRICE, WALTER V., determination of cheese lipase, 31; lipase activity in Cheddar cheese, 39; determination of cheese proteinase, 47; proteinase content of Cheddar cheese, 55; efficiency in Cheddar cheese manufacture, 711*; sampling cheese for analysis, 712*; diacetyl in Cheddar cheese, 713*
PRINCE, P. W., agitation and livability of spermatozoa, 839
PROUTY, C. C., growth of lactic streptococci in presence of bacteriophage, 859
PRUCHA, M. J., direct microscopic count for pasteurized milk, 708*
PYENSON, HARRY, iron and copper in non-milk products for ice cream, 269; powdered cream for whipping by aeration, 539; butterfat test for ice cream, 905

RAGSDALE, A. C., cardiorespiratory activities and heat production, 666*; maximum roughage for heifers, 691*
RALSTON, N. P., crossing inbred Holsteins, 657*
RAMSER, J. H., stack finishing of baled hay, 688*
RANDALL, RAYMOND, keeping quality of frozen homogenized milk after thawing, 805; keeping quality of frozen homogenized milk, 811
RAO, S. R., method for free fatty acids in dairy products, 719*
RAY SARKAR, B. C., vitamin A of butterfat, 165; colostrum carotene and vitamin A, 479
REAVES, P. M., feeding dairy calves remade skim milk, 1; barn vs. field cured alfalfa, 687*
REDFERN, R. B., stabilizers and emulsifiers in ice cream, 703*
REECE, RALPH P., estrogen and mammary duct growth, 661*
REGAN, W. M., crossing inbred Holsteins, 657*
REID, J. J., bacterial flora of udders, 667*
REID, J. T., pH change as test of semen quality, 383; concentrate feeding and bull growth, 429; semen production and concentrate mixtures for young bulls, 439
REINBOLD, G. W., mechanical can washing, 724*
REITER, TULY, udder clipping and quality of milk, 323
RICHARDSON, G. A., milk lipids and the foaming of milk, 223
ROJAS, JORGE, lactose utilization by calves, 81
ROLLINS, GILBERT H., barn vs. field cured alfalfa, 687*
ROSS, R. H., utilization of various forms of vitamin A, 111; supplemental vitamin A for heifers, 1062
RUPEL, I. W., lactose utilization by calves, 81

SAARINEN, V. P., biochemistry and histopathology of bovine ketosis, 667*
SADHU, D. P., lactose content of milk and the cerebroside and choline content of brain, 347
SAGER, OSCAR S., milk preservation for phosphatase test, 705*; microbial and milk phosphatase, 705*; lactobacilli and streptococci in Cheddar cheese, 716*; heat inactivation of phosphatase, 845
SALISBURY, G. W., livability of spermatozoa, 763; livability of spermatozoa, 769; bulls fed rations low in carotene, 799; sulfanilamide in bull semen, 817
SALSBURY, R. L., pH change as test of semen quality, 383; concentrate feeding and bull growth, 429; semen production and concentrate mixtures for young bulls, 439
SANDERS, GEORGE P., milk preservation for phosphatase test, 705*; microbial and milk phosphatases, 705*; lactobacilli and streptococci in Cheddar cheese, 716*; heat inactivation of phosphatase, 845
SCHABINGER, J. R., mammary development and body weight, 95

SCHAFFER, P. S., linoleic acid in butterfat, 720*
SCHOENLEBER, L. G., alfalfa preservation, 688*
SCHROEDER, CHARLES R., sulfamethazine blood and milk concentrations, 103
SCHULTZE, A. B., thyroxine treatment of bovine semen, 682*; thyroxine and bovine spermatozoa, 946
SCHWEIGERT, B. S., lactose utilization by calves, 81
SEATH, D. M., water sprinkling of cows, 361; semen dilution and cooling, 551; summer cooling of cows, 693*
SEELEY, D. B., quaternary salts as influenced by water constituents, 723*
SELLERS, ALVIN F., sacral deformity in cattle, 797
SHAFFER, H. E., staining bovine spermatozoa, 677*
SHAW, J. C., soybeans and vitamin A requirements, 665*; biochemistry and histo-pathology of bovine ketosis, 667*
SHEPHERD, J. B., antirachitic value of hays, 489; alfalfa preservation, 688*; renovation of pastures, 697*
SHEURING, J. J., sweetened condensed whole milk for caramel manufacture, 702*; mannitol of beef fat in ice cream, 704*
SHUART, C. E., multiple births in a Holstein-Friesian herd, 241
SHUMAKER, M. LEE, H.T.S.T. pasteurization for chocolate milk, 707*
SINGH, R. N., coliform bacteria in butter, 726*
SLATE, R. J., fetal liver stores of vitamin A, 670*; prepartum milking and blood constituents, 684*; prepartum milking and colostrum composition, 685*; composition of first colostrum, 686*
SMITH, EMIL L., immune proteins of milk and colostrum: a review, 127
SMITH, G. FREDERICK, butterfat test for ice cream, 905
SMITH, VEARL R., blood calcium at parturition, 173; preparation and rate of milking, 589; effect of udder inflation, 683*; citric acid levels in bovine blood and urine, 683*; non-milking after parturition and blood conconstituents, 684*; time of milking and milk production, 694*
SNYDER, WALTER E., fat emulsion in creams, 704*
SOMMER, H. H., fat emulsion in creams, 704*; chemical methods of studying Cheddar cheese ripening, 714*; method for free fatty acids in milk products, 719*
SPECK, MARVIN L., H.T.S.T. pasteurization of chocolate milk, 707*
SPIELMAN, A. A., prepartum vitamin A supplementation, 669*; fetal liver stores of vitamin A, 670*; prepartum milking and blood constituents, 684*; prepartum milking and colostrum composition, 685*; composition of first colostrum, 686*
SPUR, BERNHARD, curd tension and curd number tests on homogenized milk, 199
SPURGEON, K. R., hypochlorites and quaternary ammonium compounds as plant germicides, 724*
SQUIBB, R. L., effect of soybeans on plasma carotene and vitamin A, 421; feeding soybean products, 664*
STABILE, JOSEPH N., keeping quality of frozen homogenized milk after thawing, 805; keeping quality of frozen homogenized milk, 811
STALLARD, J. E., central laboratory testing, 727*
STALLCUP, O. T., maximum roughage for heifers, 691*
STODDARD, G. E., permanent rumen fistula, 668*; calf dehorning, 693*
STONE, E. J., hyaluronidase in bull semen, 678*
STONE, W. K., chemical changes in limburger cheese, 710*
STULL, J. W., nordihydroguaiaretic acid as an antioxidant, 449; nordihydroguaiaretic acid in unsweetened frozen cream, 1024
SUTTON, T. S., changes in tryptophan content of blood plasma of calf, 183; soya-phosphatides and vitamin A, 461; colostrum feeding, 523; dietary tryptophan and niacin excretion, 675*; photolyzed milk diet for calves, 675*; physiological effects of dietary lactose, 716*; dietary tryptophan and excretion of niacin, 909; riboflavin deficiency in calves, 976
SWANSON, A. M., amino acids in ripening Cheddar cheese, 715*; casein separation and fractionation, 718*
SWANSON, ERIC W., egg yolk in semen diluters, 680*; early- and late-cut lespedeza hay, 690*
SWANSON, R. G., feeding thyroprotein, 660*
SWEETMAN, W. J., testis biopsy and semen characteristics, 679*; alfalfa preservation, 688*; renovation of pastures, 697*
SYKES, J. F., spinal fluid pressure method for carotene requirements, 533; soybeans and

vitamin A requirements, 665; testis biopsy and semen characteristics, 679*

TANABE, T., bulls fed rations low in carotene, 779
TARASSUK, N. P., the browning reaction in milk powder and ice cream mix powder, 255
TALLMAN, K. L., bacteria in bovine semen, 681*
TATTER, C. W., α- and ß-lactose in dry milk products, 701*
THOMAS, J. W., antirachitic value of hays, 489; thyroprotein feeding in successive lactations, 661*; fluctuations of blood plasma vitamin A, 671*; vitamin D and curing procedure, 689*
THOMASON, JOHN H., sweet potatoes in ration of dairy cows, 341
THORP, F., JR., carbohydrate comparisons in synthetic rations for calves, 674*
THORP, W. T. S., effect of penicillin upon bovine semen, 11; streptomycin treatment for bovine semen, 501
TITTSLER, RALPH P., microbial and milk phosphatases, 705*; lactobacilli and streptococci in Cheddar cheese, 716*
TRACY, P. H., iron and copper in non-milk products for ice cream, 269; nordihydroguaiaretic acid as an antioxidant, 449; powdered cream for whipping by aeration, 539; stale flavor of dried whole milk, 700*; sweetened condensed whole milk for caramel manufacture, 702*; mannitol of beef fat in ice cream, 704*; phosphatase inactivation, 706*; closure seepage with homogenized milk, 722*; mechanical can washing, 724*; gas from whole milk powder, 831; H.T.S.T. inactivation of phosphatase, 867; H.T.S.T. inactivation of lipase, 881; nordihydroguaiaretic acid in unsweetened frozen cream, 1024
TRETSVEN, WAYNE I., pH control of fermented dairy products, 710*
TROUT, G. M., nutritive value of homogenized milk: a review, 627; judging dairy products, 823
TUCKEY, S. L., chemical changes in limburger cheese, 710*; *Oospora lactis* and ripening of Cheddar cheese, 713*; mechanical can washing, 724*
TURK, K. L., prepartum vitamin A supplementation, 669*
TURNER, C. W., endocrine secretion as a genetic tool, 658*; thyroid secretion rate, 659*; male hormone content of cow manure, 1032
TYLER, W. J., heritability of Ayrshire type ratings, 63; variations in Ayrshire type ratings, 71; prediction of butterfat production, 657*; age and type rating of Ayrshires, 663*
TYSDAL, H. M., alfalfa preservation, 688*

UNDERWOOD, P. C., testis biopsy and semen characteristics, 679*

VAN LANDINGHAM, A. H., prepartum milking and colostrum composition, 685*
VAN PELT, M. D., aerobic bacteria and feces consistency, 673*

WAGENAAR, R. O., growth of lactic streptococci in presence of bacteriophage, 859
WAGNER, R. E., renovation of pastures, 697*
WALLENFELT, EVERT, interdepartmental cooperation in dairy extension, 728*
WARD, G. M., pH change as test of semen quality, 383; concentrate feeding and bull growth, 429; semen production and concentrate mixtures for young bulls, 439; time of milking and milk production, 694*
WARNER, R. G., photolyzed milk diet for calves, 675*; riboflavin deficiency in calves, 976
WASHBURN, R. G., winter pasture and milk carotenoids, 697*
WATROUS, G. H., JR., hypochlorite and quaternary ammonium compounds as udder washes, 179
WEAKLEY, C. E., JR., prepartum milking and colostrum composition, 685*
WEBB, B. H., storage and viscosity of sweetened condensed milk, 21; crystalline deposit in evaporated milk, 123; whey utilization: a review, 139; viscosity and heat stability of concentrated milks, 701*
WECKEL, K. G., udder clipping and quality of milk, 323
WEISER, HARRY H., biochemical activity of lactic culture bacteria grown in cow's and soybean milk, 213
WELSH, MARK, Sulfamethazine blood and milk concentrations, 103
WERNER, GEORGE, interdepartmental cooperation in dairy extension, 728*
WHITING, F., tocopherols and fat content of

milk, 665*; covitamin studies of milk fats, 666*; freezing and fat oxidation, 721*; stability of milk fat and fat-soluble vitamins, 961

WHITNEY, R. McL., stale flavor of dried whole milk, 700*; direct nesslerization of digested milk, 718*

WHITTIER, EARLE O., whey utilization: a review, 139

WILBUR, J. W., mow curing of baled hay, 687*

WILLIAMS, P. S., hypochlorite and quaternary ammonium compounds as udder washes, 179

WILSTER, G. H., nonfat dry milk solids in Cheddar cheese manufacture, 712*

WINDER, WILLIAM C., sampling cheese for analysis, 712*

WINDHAM, EARNEST, keeping quality of frozen homogenized milk after thawing, 805; keeping quality of frozen homogenized milk, 811

WISE, G. H., carotene and vitamin A absorption, 671*; form of vitamin A and tocopherol supplements, 686*; nitrogenous constituents of colostrum, 889

WISEMAN, H. G., spinal fluid pressure method for carotene requirements, 533; alfalfa preservation, 688*

WORSTELL, D. M., cardiorespiratory activities and heat production, 666*

WRIGHT, PHILIP A., ascorbic acid and keeping quality of dried milk, 698*; antioxidant formation by processing, 698*; lipolysis prevention by heat treatment, 700*

WYLIE, C. E., early- and late-cut lespedeza hay, 690*; wintering heifers on legume hay, 692*; silage vs. winter pasture, 695*; irrigated pastures, 696*

ZAKARIASEN, BEN M., sediment tests for cream, 725*

ZIMMERMAN, P. L., volatile acidity of evaporated milk, 189

ACID, formic, determination in evaporated milk, 189
Acid production, factors affecting, in cheese cultures, 709*
Acids, volatile, determination in evaporated milk, 189
Aerobacter aerogenes, effect on soluble nitrogen of milk, 726*
Agitation, and livability of bovine spermatozoa, 839
Air movement, effect of, on cooling cows, 361
Alfalfa,
  dehydrated, carotene preservation in, 1008
  vitamin D in, influence of curing procedure on, 689*
Alfalfa pasture, as influencing rumen gas formation, 1016
Alpha-lactose, water of crystallization of, estimation in dry whey solids, 619
American Dairy Science Association,
  list of members and student affiliates, 1071
  President's address at the 43rd annual meeting, 731
  program of 43rd annual meeting, 389
  report of 43rd annual meeting, 740
  winners of the intercollegiate dairy products judging contest, 1948,
Amino acids,
  addition to Cheddar cheese, 715*
  freed in Cheddar cheese ripening, 715*
Anemia, in calves, iron alleviation of, 676*
Antioxidant,
  nordihydroguaiaretic acid, in milk, 449
  nordihydroguaiaretic acid, in unsweetened frozen cream, 1024
Antioxidants, formation by special processing of dried milk, 698*
Artificial insemination,
  order number of, conception rate and, 683*
  pregnancy examinations and non-returns, as measure of efficiency of, 682*
Ascorbic acid,
  addition to milk, 99
    effect on keeping quality of dried milk, 698*
  in plasma of calves,
    ration influence on, 672*
    effect of ration and rumen development on, 1055
  in oxidative deterioration of milk fat, 961
  oxidation by hydrogen peroxide in milk, 721*
  relation to light-induced oxidation in homogenized milk, 722*
  retention in frozen milk, 951
Ayrshire cows, variations in type rating, 71

BACTERIA,
  in diluted bull semen,
    control by drugs, 763
    effect of sulfonamides on, 769
  in milk, influence of udder clipping on, 323
Bacterial flora, of udders, influence of sampling at various milking stages, 667*
Bacteriophage,
  of *S. lactis*,
    electron microscope studies of, 709*
    production by *S. lactis*, 708*
    adaptation to growth in presence of, 859
    ultraviolet irradiation of, 509
β-carotene, utilization by heifers, 111
Births, multiple in a Holstein-Friesian herd, 241
Bloat, alfalfa, sugar and starch for production of, 668*
Blood,
  composition of,
    effect of prepartum milking on, 684*
    without postpartum milking, 684*
  sulfamethazine concentration in, 103
Blood plasma, of calf, tryptophan content of, influence of colostrum on, 183
Blood serum, calcium in, influence of partial vs. complete milking at parturition on, 173
Body weight, of cattle, relation to mammary development, 95
Breed, influence on vitamin content of milk fat, 666*
Breeding behavior, of bulls fed rations low in carotene, 779*
Browning reaction, in whole milk and ice cream powders, 255
Bulls,
  concentrates for feeding of, 429
  semen production by, influence of concentrates on, 439

Bull semen, fertility level of, influence of sulfanilamide, 817
Butter,
coliform bacteria in, 726*
fat oxidation at freezing temperature in, 721*
Butterfat,
determination in ice cream, using mixed perchloric and acetic acids, 905
linoleic measurement in, 720*
nutritive value of fractions of, 793
vitamin A in, influence of season, breed and species on, 165
Butterfat production,
annual, and month of calving, 1029
prediction from own record vs. progeny test, 657*
relation to type rating in Ayrshire cows, 63
Buttermilk, foaming of, influence of lipids on, 223

CALCIUM,
in blood serum, influence of partial vs. complete milking at parturition on, 173
in plasma, effect of supplemental vitamin A on, 1062
plasma concentration of, in breeding bulls, 429
Calcium citrate, in crystals in evaporated milk, 123
Calf, tryptophan in blood plasma of, as influenced by colostrum, 183
Calf losses, causes in a closed herd, 669*
Calf selection, for 4-H Club work, 728*
Calves,
absorption of carotene and vitamin A by, 671*
anemia in, iron alleviation of, 676*
benefit of colostrum for raising of, 523
blood composition of, when fed remade skim milk, 1
blood vitamin values of, ration influence on, 672*
carbohydrates in, synthetic rations for, 674*
carotene requirements of, determination by spinal fluid pressure, 533
dehorning of, 693*
effect of prepartum vitamin A supplement on, 669*
fecal flora of, 673*
growth of, on remade skim milk, 1
microorganisms in digestive tracts of, ration influence on, 672*
new-born, use of fetal liver stores of vitamin A by, 670*
plasma of, effect of ration and rumen development on composition of, 1055
raising without colostrum, 674*
riboflavin deficiency in, 976
riboflavin deficiency of photolyzed milk diet for, 675*
rumen microorganisms of,
influence of grain-hay ratio on, 1051
influence of ration and inoculation on, 1041
lactose utilization by, 81
vitamin A in blood plasma of, fluctuations caused by ration variations, 671*
Calving, month of, relation to butterfat production, 1029
Carmels, sweetened condensed whole milk for manufacture of, 702*
Carotene,
calf absorption of, effect of administration method on, 671*
in blood plasma, genetic variation of, 658*
in blood serum, influence of soybeans on, 421
in bull rations, influence on breeding behavior, etc., 779
in colostrum of Indian cows, 479
in first milking postpartum, 686*
in milk,
destruction by photolysis, 976
effect of rye pasture on, 697*
in plasma, effect of supplemental vitamin A on, 1062
of bovine blood plasma, effect of soybean products on, 664*
of milk fat, effect of soybean products on, 664*
requirements for calves, determination by spinal fluid pressure, 533
Carotene preservation, in feeds, 1008
Carotenoids, in plasma of calves, effect of ration and rumen development on, 1055
Casein, separation and fractionation of, 718*
Cationic germicides, milking machine inflation treatment with, 331
Central laboratory testing, for DHIA cow testing, 727*
Cereal grasses, dehydrated, carotene preservation in, 1008
Cerebrosides, brain content of, relation to lactose content of milk, 347

Cervical mucus, spermatozoa behavior in, 679*
Cheese,
blue, manufacture from pasteurized homogenized milk, 611
Cheddar,
added amino acids and flavor of, 715*
amino acids freed during ripening of, 715*
diacetyl as a flavor constituent in, 713*
effeciency and costs in manufacture of, 711*
flavor of,
as influenced by *S, faecalis*, 275
relation of tyramine content and *S. faecalis* numbers to, 305
growth and survival of *S. faecalis* in, 285
influence of lactobacilli and streptococci on flavor and quality of, 716*
influence of *Ospora lactis* on fat changes in, 713*
lipase activity in, 39
nitrogen partition method for, 714*
nonfat dry milk solids for fat standardization of, 712*
pasteurization by radio-frequency heat, 710*
phosphatase inactivation in, 845
proteinase in, 55
sampling for analysis, 712*
S. faecalis as starter for, 275
tryamine content of, 293
influence of ripening temperature on, 714*
determination of lipase in, 31
Kay-Graham phosphatase test for, 561
limburger, chemical changes during accelerated ripening of, 710*
proteinase of, determination of, 47
Cheese cultures, factors affecting acid production by, 709*
Chocolate liquors, iron and copper content of, 269
Choline, of brain, relation to lactose content of milk, 347
Citric acid, levels in blood and urine at parturition, 683*
Clipping, of udder, influence on milk quality, 323
Cocoa, iron and copper content of, 269
Coliform bacteria, in butter, 726*
Collegiate Students' International Contest in Judging Dairy Products,
analysis of 1947 results, 823
1948 results, 1068
Color, determination, in evaporated milk, 409
Colostrum,
carotene, vitamin A and other components, 686*
carotene and vitamin A in, 479
effect of prepartal milking on, 685*
composition of, effect of prepartum milking on, 685*
immune proteins in, 127
ingestion of, tryptophan of calf blood plasma influenced by, 183
nitrogenous constituents of,
effect of prepartal rations upon, 889
post-partal changes in, 889
use for raising calves, 523
vitamin A and carotene in, effect of feeding vitamin A and tocopherols on, 686*
Concentrates,
for feeding breeding bulls, 429
feeding of, influence on semen production of bulls, 439
Cooling,
delayed, effect upon bull semen, 551
of cows, by water sprinkling and air movement, 361
of dairy cows in summer, 693*
Cows,
cooling of, by water sprinkling, 361
sweet potato meal for, 341
Copper, in non-milk constituents of ice cream, 269
Cream,
color test for grading of, 577
fat emulsions in natural and artificial, 704*
foaming of, influence of lipids on, 223
frozen, milk fat oxidation in, 721*
grading of, color test for, 577
powdered, manufacture for aeration whipping, 539
sediment test for 725*
skunk-like odor of, 725*
unsweetened frozen, nordihydroguaiaretic acid an antioxidant for, 1024
Crystalline deposit, in evaporated milk, composition of, 123
Curd number test, on homogenized milk, 199
Curd tension test, on homogenized milk, 199
Curing, of hay, vitamin D influenced by, 489

DAIRY records committee, report of, 727*
Dehorning, of calves, with antimony trichloride-salicylic acid-collodion preparation, 693*

Diacetyl, as a flavor constituent in Cheddar cheese, 713*
Diluter, egg yolk, for bull semen, 680*
Dilution, delayed, effect on bull semen, 551
Direct microscopic count, for pasteurized milk, 708*
Dried milk powder, antioxidants in, formation by processing, 698*
Dry whole milk,
  acid ferricyanide and indophenol reducing substances of, formation during storage, 986
  fluorescent materials in, 367
  heat-produced reducing systems in, 699*
  α-lactose estimation in, 619
  moisture content of, and storage changes, 986
  storage deterioration of, 986
  storage temperature and storage changes, 986

EMULSIFIERS, for ice cream, 703*; 704*
Endocrine secretion, genetic selection on basis of, 658*
Escherichia coli,
  effect on soluble nitrogen in milk, 726*
  in calf feces, 673*
Evaporated milk,
  chemical composition of crystalline deposit in, 123
  volatile acids of, determination of, 189
Extraneous matter, in milk, influence of udder clipping upon, 323

FAT content, of milk, influence of tocopherol feeding on, 557
Fat emulsion, in natural and artificial creams, 704*
Fatty acids, free, measurement in dairy products, 719*
Feces, consistency of, aerobic bacterial flora and, 673*
Feeding intensity, influence on live weight and milk-energy yield, 119
Ferricyanide method, reducing capacity of milk measured by, 595
Flame photometer, Ca, K and Na detection in milk with, 717*
Fluorescent materials, in milk and milk products, 367
Foaming, of milk, cream and buttermilk, effect of phospholipids on, 223
Fruit extracts, iron and copper content of, 269
Furacin, and spermatozoa livability, 763

GAS formation, in rumin, influence of alfalfa pasture on, 1016
Genetic selection, endocrine secretion as method for, 658*
Genetic variation, in carotene and vitamin A in bovine blood plasma, 658*
Gestation, influence on heat production and cardiorespiratory activities, 666*
Glutathione, plasma concentration of, in breeding bulls, 429
Glycerol dichlorohydrin, for vitamin A and carotene determination, 421
Grain, as supplement for maximum roughage, 691*
Grapefruit peel, dried, lactating factors in, 691*, 973

HAY,
  alfalfa
    baled field vs. mow curing, 687*
    barn vs. field curing of, 687*
    barn-cured vs. field cured vs. wilted silage for feed value and nutrients, 688*
  baled, stack curing with and without heat, 688*
  legume, for wintering heifers, 692*
  lespedeza, early-cut vs. late-cut for milk production, 690*
  milk production, vitamin content and flavor influenced by six types of, 690*
  sun-cured vs. barn-cured, digestible materials in, 691*
  vitamin D content of, influence of curing on, 489
Heat-induced flavor compounds, isolation from milk, 707*
Heifers,
  maximum roughage for, 691*
  utilization by, of β-carotene, vitamin A alcohol and natural ester of vitamin A, 111
  wintering on legume hay, 692*
Hemoglobin, plasma concentration of, in breeding bulls, 429

Heritability, of type rating, in Ayrshire cows, 63
Holstein-Fresians, multiple births among, 241
Holsteins, growth and milk production from crossing 2 inbred lines, 657*
Hormone, male, content in cow manure, 1032
Hyaluronidase,
activity in bull semen, 678*
determination in bull semen, 678*
Hypochlorites,
germicidal effectiveness of, 724*
udder washes of, influence on plate counts of milk, 179

ICE cream,
butterfat determination in, using mixed perchloric and acetic acids, 905
iron and copper in non-milk constituents of, 269
stabilizers and emulsifiers for, 703*
Ice cream mix, effect of water minerals on, 703*
Ice cream powder, browning reaction in, 255
Immune proteins, of milk and colostrum, 127
Inbred lines, crossing of, effect on growth and milk production, 657*
Inflations, of milking machines, treatment and storage of, 331
Interdepartmental cooperation in dairy extension, 728*
Iron, in non-milk constituents of ice cream, 269

JUDGING of dairy products, analysis of 1947 results of intercollegiate contest, 823

KETOSIS, biochemical and histopathological study of, 667*

LACTATING factors, in dried grapefruit peel, 973
Lactation, influence on heat production and cardiorespiratory activities, 666*
Lactobacilli, influence on flavor and quality of Cheddar cheese, 716*
Lactoglobulins, in colostrum, 127
Lactose,
determination of α and β, in dry milk products, 701*
physiological effects in diet, 716*
utilization by calves, 81
Let-down of milk, relation to pre-milking management, 694*
Leucocytes, numbers in milk, 723*
Linoleic acid, determination in butterfat, 720*
Lipase,
from *Mycotorula lipolytica*, blue cheese manufacture with, 611
heat treatment to prevent lipolysis in dried product, 700*
in Cheddar cheese, 39
inactivation by H.T.S.T. pasteurization, 881
of cheese, determination of, 31
rate in foaming of milk, etc., 223
Liveweight, relation to milk-energy yield, 119
Lye, milking machine inflation treatment with, 331

MAMMARY development, relation to body weight, 95
Mammary duct growth, estrogen effect upon, 661*
Mannitol of beef fat, emulsifying and other effect on ice cream, 704*
Manometric measurement, of gas desorbed from powdered whole milk, 831
Manure, cow, factors influencing male hormone content of, 1032
Members, American Dairy Science Association, 1071
Microorganisms, in digestive tracts of calves, ration influence on, 672*
Milk,
addition of ascorbic acid to, 99
bacteriological quality of, influence of udder clipping on, 323
bulk condensed, microbiological keeping quality of, 702*
Ca, K and Na in, flame photometer for determination of 717*
carotene and vitamin A in, effect of winter rye pasture on, 697*
chocolate, H.T.S.T. pasteurization for, 707*
color of, spectrophotometric determination of, 409
composition of, influence of tocopherol feeding on, 557
concentrated, viscocity and heat stability of, influence of processing temperatures on, 701*
evaporated,

MILK—*continued*
composition of crystalline deposit in, 123
determination of color of, 409
influence of processing on color of, 415
volatile acids of, determination of, 189
fat content of, tocopherol influence on, 665*
fluorescent materials in, 367
foaming of, influence of lipids on, 223
frozen,
ascorbic acid retention in, 720*; 951
O–R potential, changes in, 720*; 951
prevention of oxidized flavor in, 720*; 951
frozen homogenized,
age before freezing and keeping quality, 811
keeping quality after thawing, 805
homogenized,
curd number test of, 199
curd tension test of, 199
influence of vitamin C on light-induced oxidation in, 722*
nutritive value of, 627
seepage from bottles of, 722*
immune proteins in, 127
in diets for calves, utilization of, 81
lactose content of, relation of cerebroside and choline content of brain to, 347
leucocyte count of, 723*
nordihydroguaiaretic acid as an antioxidant in, 449
phosphatase inactivation in, 845
photolysis of, for vitamin destruction, 976
plate count of, as influenced by udder washes, 179
preservation of, for phosphatase test, 705*
reducing capacity of,
ferricyanide method for measuring, 595
influence of heat treatment and spray drying upon, 595
reducing systems of, heat treatment and production of, 699*
soluble nitrogen in, influence of *S. lactis* and coliform bacteria on, 726*
sulfamethazine concentration in, 103
sweetened condensed whole, for manufacture of caramels, 702*
vitamin A in, determination of, 315
watered, limitations of refractometer readings for detection of, 717*
Milk cans, sanitization of, in mechanical can washers, 724*
Milk-energy yield, as influenced by feeding intensity, 119
Milk fat,
fractionation by molecular distillation, 719*
oxidation of, determination by re-emulsification test, 721*
stability of, determination by re-emulsification test, 961
tocopherol, vitamin A and carotenoids of, 666*
Milking,
effect of time from preparation to milking on yield, 694*
partial vs. complete, effect on blood serum Ca at parturition, 173
rate of, effect of preparation on, 589
Milking machines, inflations for, treatment and storage of, 331
Milk powder, whole, browning reaction in, 255
Milk production,
crossing inbred lines for, 657*
influence of penkeeping system in Brazil on, 203
Mixed feeds, carotene preservation in, 1008
Moisture content, of feeds, influence on carotene preservation, 1008
Molecular distillation, for fractionation of milk fat, 719*
Mycotorula lipolytica, lipase from, blue cheese manufacture using, 611

NESSLERIZATION, direct, for nitrogen in milk, 718*
Niacin,
urinary secretion by calves, tryptophan feeding and, 675*; 909
Nitrogen, in milk, direct Nesslerization for, 718*
Nitrogen partition, in ripening Cheddar cheese, 714*
Nonfat dry milk solids, standardization of Cheddar cheese fat content with, 712*
Nordihydroguaiaretic acid, as antioxidant,
in milk, 449
in unsweetened frozen cream, 1024

OOSPORA *LACTIS*, influence on fat changes in Cheddar cheese, 713*
Oxidation-reduction potential, of frozen milk, 951
Oxidized flavor,
in milk and milk products (review), 913
prevention in frozen milk, 951

Oxygen consumption, of semen and spermatozoa, effect of thyroxine on, 946
Oxytocin, reducing fluctuation of milk and fat yields with, 662*

PARTURIENT paresis,
effect of partial vs. complete milking on, 173
udder inflation effect on blood Ca, Mg and inorganic P in, 683*
Pasteurization, H.T.S.T.,
for chocolate milk, 707*
lipase inactivation by, 881
phosphatase inactivation by, 867
Pasture,
feed from, 353
for southern dairying, 696*
irrigated, for dairy cattle, 696*
permanent, renovation for, 697*
rye, effect on carotene and vitamin A of milk, 697*
winter, value for dairy cows, 897
winter, vs. silage, 695*
Penicillin,
and spermatozoa livability, 763
effect on bovine semen, 11
semen fertility influence of, 681*
Penkeeping system, for milk cows in Brazil, 203
Perchloric acid, for butterfat determinations in ice cream, 905
pH control, in fermented dairy products, 710*
Phenoxethol, and spermatozoa livability, 763
Phosphatase,
differentiation of microbial from milk type, 705*
distribution in milk fractions, 867
heat inactivation of, 845
inactivation by H.T.S.T. pasteurization, 867
time and temperature relationships for inactivation, 706*
Phosphatase test,
Kay-Graham, for cheese, 561
preservation of milk for, 705*
Phospholipids, role in foaming of milk, etc., 223
Phosphorus,
in plasma, effect of supplemental vitamin A on, 1062
plasma concentration of, in breeding bulls, 429
Powdered whole milk,
added ascorbic acid and keeping quality of, 698*
density of, 935
distribution of stale flavor in, 700*
gas desorbed from, manometric measurement of, 831
keeping quality of, influence of preheating and precondensing on, 517
solubility of, 935
Precondensing, effect on keeping quality of powdered whole milk, 517
Pregnancy examination, measuring insemination efficiency by, 682*
Preheating temperatures, influence on quality of powdered whole milk, 517
Prepartal rations, effect on nitrogenous constituents of colostrum, 889
Prepartum milking,
carotene and vitamin A in colostrum affected by, 685*
colostrum composition affected by, 685*
effect on blood constituents, 684*
Progeny test, for prediction of butterfat production, 657*
Proteinase,
of Cheddar cheese, changes during ripening, 55
of cheese, determination of, 47
Pyridium, and spermatozoa livability, 763

QUATERNARY ammonium compounds,
germicidal effectiveness of, 724*
influence of water constituents on, 723*
udder washes of, influence on plate counts of milk, 179

RADIO-FREQUENCY heat, for pasteurization of Cheddar cheese, 710*
Reducing capacity, of milk, ferricyanide method for measuring, 595
Re-emulsification test, for fat stability, 961
Refractometer, detection of watered milk with, 717*
Respiratory infections, calf losses due to, 669*
Revision of DHIA rules and regulations, 729*
Riboflavin,
calf deficiency of, on photolyzed milk diet, 675*
deficiency of, and blood vitamin A and ascorbic acid in calves, 976
in milk, destruction by photolysis, 976

Roughages, vitamin D in, 455
Rumen,
gas formation in, influence of alfalfa pasture on, 1062
microorganisms in,
influence of calf rations on, 673*
effect of grain-hay ratio on, 1051
effect of ration and rumen inoculation on, 1041
Rumen fistula, for dairy cows, 668*

ACRAL deformity, in "wrytail" abnormality of cattle, 797
Sediment test, for cream, 725*
Seepage, from bottled homogenized milk, 772*
Semen,
bacteria in, 681*
influence of drugs on, 763
bacterial content of, effect of penicillin on, 11
effect of penicillin on, 11
egg yolk diluter for, 680*
fertility of, influence of penicillin on, 681*
glycolysis, effect of pencillin on, 11
hyaluronidase activity of, 678*
hyaluronidase determination in, 678*
keeping quality of, effect of delay in diluting and cooling on, 551
livability, effect of pencillin on, 11
motility at 100° F. as index of quality, 677*
motility of, influence of bacteria on, 681*
oxygen consumption of, effect of thyroxine on, 946
pH change during incubation of, 383
production by bulls, influence of concentrate feeding on, 439
streptomycin in, livability and bacterial content influenced by, 501
testis biopsy influence on characteristics of, 679*
thyroxine in, effects on breeding results, 682*
Semen production, of bulls fed rations low in carotene, 779
Serum, bovine, carotene and vitamin A in, influence of soybeans on, 421
Silage, vs. winter pasture, for dairy cows, 695*
Skim milk, remade, effect on calves, 1
Soya-phosphatides, vitamin A absorption and retention influenced by, 461
Soybean milk, substratum for *S. lactis* and associates, 213
Soybean products, feeding of, effect on carotene and vitamin A, 664*
Soybeans,
feeding of, influence on vitamin A requirements, 665*
raw, influence of on carotene and vitamin A of bovine serum, 421
Spectrophotometer, color determination in evaporated milk with the, 409
Spermatogenesis,
hormone influence on, 663*
of bulls fed rations low in carotene, 779
Spermatozoa,
behavior in bovine cervical mucus, 679*
livability of,
effect of agitation on, 839
effect of sulfonamides on, 769
influence of drugs upon, 763
oxygen consumption of, effect of thyroxine on, 946
staining with eosin-aniline blue, 677*
Spinal fluid pressure method, for determination of carotene requirements of calves, 533
Sprinkling, cooling of cows by, 361
Sprinkling device, summer cooling of cows with, 694*
Stabilizers,
for ice cream, 703*
iron and copper content of, 269
Stale flavor, of whole milk powder, 700*
Streptococci, influence on flavor and quality of Cheddar cheese, 716*
Streptococcus agalactiae, influence on leucocyte counts of milk, 723*
Streptococcus citrovorous, comparative activity in cow's and soybean milks, 213
Streptococcus faecalis,
as starter for Cheddar cheese, 275
growth and survival in Cheddar cheese, 285
numbers of, relation to tyramine content and flavor of Cheddar cheese, 305
Streptococcus lactis,
adaptation to homologous bacteriophage, 859
bacteriophage for,
electron microscope studies of, 709*
ultraviolet irradiation of, 509
bacteriophage production by, 708*
comparative activity in cow's and soybean milks, 213
effect on soluble nitrogen of milk, 726*

Streptococcus paracitrovorous, comparative activity in cow's and soybean milk, 213
Streptomycin, preservative for bovine semen, 501
Student affiliates, American Dairy Science Association, 1071
Sudan grass, sweet, as forage for dairy cattle, 695*
Sugar, iron and copper content of, 269
Sulfamethazine, blood and milk concentrations in dairy cows, 103
Sulfanilamide, effect on fertility level of diluted bull semen, 817
Sulfonamides,
  effect on livability of spermatozoa, 769
  for control of bacteria in diluted bull semen, 769
Sweetened condensed milk, viscosity of, as influenced by storage, 21
Sweet potato meal,
  for feeding cows, 341
  value for dairy cows, 897
Sweet potatoes, dehydrated, as concentrate for dairy cattle, 569
Synthetic rations for calves, carbohydrate sources in, 674*

TESTIS biopsy, influence on semen characteristics, 679*
Thyroid secretion rate, relation to physiological processes, 659*
Thyroprotein, feeding of,
  during successive lactations, 661*
  during summer, 660*
  effect on various factors, 660*
Thyroxine,
  effect on oxygen consumption, by bovine spermatozoa and semen, 946
  in semen, effect on breeding results, 682*
Tocopherols,
  fat content of milk influenced by, 665*
  feeding of, and vitamin A and carotene in colostrum, 686*
  feeding to dairy cows, effect on quantity and fat content of milk, 557
Tryptophan,
  effect on urinary niacin secretion by calves, 675*; 909
  in calf blood plasma, colostrum ingestion influencing, 183
Type rating,
  heritability of, in Ayrshire cows, 63
  variation in, for individual Ayrshire cows, 71
  of Ayrshire females as heifers and cows, 663*
Tyramine,
  determination, in Cheddar cheese, 293
  in Cheddar cheese, 293
    influencing of ripening temperature on, 714*
  relation to *S. faecalis* numbers and flavor of Cheddar cheese, 305

UDDER,
  clipping of, influence on milk quality of, 323
  inflation in parturient paresis, effect on blood Ca, Mg and inorganic P, 683*
  washing of, influence on plate counts of milk, 179
Udders,
  bacterial flora of, sampling at various stages of milking, 667*
Ultraviolet, irradiation of *S. lactis* bacteriophage by, 509

VANILLA, iron and copper content of, 269
Viscosity, of sweetened condensed milk, 21
Vitamin A,
  absorption and utilization of, effect of soya-phosphatides on, 461
  blood activity values of, effect of vitamins and minerals on, 664*
  calf absorption of, effect of administration method on, 671*
  dairy cow requirements for, influence of soybeans on, 665*
  determination of, in milk, 315
  effect of season, breed and species on, in butterfat, 165
  feeding of, and vitamin A and carotene in colostrum, 686*
  fetal liver stores of, utilization by new born calf, 670*
  in blood plasma, genetic variation of, 658*
  in blood plasma of calves,
    irregular fluctuations due to feeding, 671*
    ration influence on, 672*
  in bovine serum, influence of raw soybeans on, 421
  in colostrum of Indian cows, 479

VITAMIN A—*continued*
in first milking postpartum, 686*
in milk,
destruction by photolysis, 976
effect of rye pasture on, 697*
in milk fat, effect of soybean products on, 664*
in plasma, effect of supplemental vitamin A on, 1062
in plasma of calves, effect of ration and rumen development, on, 1055
natural esters of, utilization by heifers, 111
of bovine blood plasma, effect of soybean products on, 664*
prepartum supplement of, effect on newborn calf, 669*
supplemental, effect on Holstein heifers, 1062
Vitamin A alcohol, utilization by heifers, 111
Vitamin C, see ascorbic acid
Vitamin D,
curing of hay as it influences, 489
in alfalfa cured various ways, 689*
in roughages, 455
Vitamin E,
in milk, stability in ultraviolet light, 961
milk fat deterioration and, 961

WHEY, utilization of, 139
White scours, calf losses due to, 669*
Wrytail abnormality, sacral deformity of cattle with, 797

VOLUME XXXI DECEMBER, 1948 NUMBER 12

JOURNAL OF DAIRY SCIENCE

ABSTRACTS OF LITERATURE

BOOK REVIEWS

412. Annual review of biochemistry, Vol. 17. J. M. LUCK, editor. 801 pp. $6.00. Annual Reviews, Inc., Stanford, Calif. 1948.

This volume constitutes a worthy successor to the preceding volumes in this series. As usual, the range of the material covered is extensive. The chapters are: Biological oxidations and reductions; Noncxidative enzymes; chemistry of the carbohydrates; The chemistry of the immunopolysaccharides; X-ray crystallographic studies of compounds of biochemical interest; Chemistry of the lipids; The chemistry of the proteins and amino acids; Nucleoproteins, nucleic acids, and related substances; Carbohydrate metabolism; Lipid metabolism; The metabolism of proteins and amino acids; The metabolism of drugs and toxic substances; Clinical applications of biochemistry; Biochemistry of the hormones; The vitamins; Clinical aspects of vitamins; The biochemistry of carcinogenesis; Biochemistry of the natural pigments; The terpenes (in relation to the biology of genus pinus); The alkaloids; Photosynthesis; Mineral nutrition of plants; Plant hormones; Bacterial metabolism; The chemistry of penicillin; Ruminant digestion; Physiological aspects of genetics. Of these 27 chapters, 9 are written by scientists resident in foreign countries.

The large numbers of citations of original literature permit one to refer to the original articles reviewed with a minimum of difficulty. The indexing appears to be done well. The authors and editors are to be commended for making available such a satisfactory resumé of current biochemical literature.

F. E. Nelson

BACTERIOLOGY

413. Sur l'utilisation de le chloropicrine en laiterie (On the utilization of chloropicrin in the dairy). J. PIEN, Laiterie des Fermiers Reunis, Paris, France. Lait, **28**, 271–272: 1–21. Jan.–Feb., 1948.

During 1944 it was proposed by Bertrand (Compt. rend., **219**: 230. 1948) that in emergencies milk might be preserved by the addition of chloropicrin. The term microlysation was proposed for the process, being derived from microlysine, a purified form of chloropicrin. The proposal received approval by the Academy of Medicine and by the Milk and Food Commission for temporary use. Pien reports on the practical aspects of experiments in which treated milk was placed on sale in Paris.

Chloropicrin is not readily soluble in milk and must be incorporated by vigorous agitation. In the trials conducted, concentrated lots were made up and

mixed with milk as received at country receiving stations. This milk, of poor sanitary quality and neither pasteurized nor refrigerated, was placed on sale in Paris. When treated at the rate of 50 mg. per l. the complaints were numerous and vehement due to its instability to boiling. When 80 mg. per l. was used, similar complaints were received and in addition the irritating odor and flavor, even after boiling, were noticed. Sales were discontinued after 12 d.

The rate at which acidities increased in treated milk was studied in the laboratory. Acidity changes were held in check for 2 d. at 25° C. but began to increase after 3–4 d. if the initial contamination was high. Similar results were obtained at 37° C. Upon heating, the milk separated into a smooth, fine curd and a clear upper layer. Total bacterial counts, 24 hr. after the addition of 50 mg./l. to poor quality milk, were large and consisted chiefly of lactic acid producers although large numbers of coliforms, putrifiers and spore-formers were present. The use of 80 mg./l. caused a gradual decline in numbers for 100 hr., while with only 50 mg./l., the numbers doubled in that length of time.

Additional experiments in which chloropicrin was introduced to the milk immediately after milking resulted in good inhibition of bacterial growth. It is concluded, however, that practical difficulties make the use of this disinfectant impossible on the farm. O. R. Irvine

414. Antibiotics active against bacterial viruses. I. N. Asheshov, Frieda Strelitz, and Elizabeth Hall, Univ. of Western Ontario, London, Can. Can. J. Pub. Health, **39**, 2: 75. Feb., 1948.

Paper discs soaked in substances active against bacteriophages were placed on agar plates flooded with bacteria and phage mixtures. Where the substances showed activity, the disc was surrounded by a zone of normal bacterial growth while the remaining parts of the plate would show confluent clearings of the phage.

An *Aspergillus* was found to produce 2 anti-phage substances, the first an anti-staphylophage substance, acidic in nature, stable between pH 2 and pH 10.0, which withstands heating to 100° C. It has been obtained in crystalline form. Less than 1 part in 10,000,000 by weight will inhibit staphylophage, while staphylococci require concentrations of 1 : 50,000 to 1 : 100,000 before being affected. The second substance from the same mold was active against 3 streptophages out of 12 tried. It is basic and considerably less stable than the anti-staphylophage substance. O. R. Irvine

415. Method of preparing a vitamin concentrate. N. E. Rodgers, H. L. Pollard, and R. E. Meade. (Assigned to Western Condensing Co.) U. S. Patent 2,449,144. 4 claims. Sept. 17, 1948. Official Gaz. U. S. Pat. Office, **614**, 2: 434. 1948.

The fermentation of whey and skim milk with *Clostridium acetobutylicum* for the purpose of making a vitamin concentrate, including riboflavin, is improved through the use of a starter which has been transferred a sufficient number of times to give an acidity of at least 4%. All transfers are made within 2 to 5 hours after the maximum acidity is reached. R. Whitaker

416. Method of enhancing the yield of vitamins in fermentation. H. L. POLLARD, N. E. RODGERS, AND R. E. MEADE. (Assigned to Western Condensing Co.) U. S. Patent 2,449,140. 4 claims. Sept. 14, 1948. Official Gaz. U. S. Pat. Office, **614**, 2: 433. 1948.

When whey and skim milk are fermented with *Clostridium acetobutylicum*, the vitamin content, particularly riboflavin, is enhanced by the addition of iron and a soluble ammonium salt in a predetermined amount and ratio.

R. Whitaker

417. Fermentation method for preparing a vitamin concentrate. H. L. POLLARD, N. E. RODGERS, AND R. E. MEADE. (Assigned to Western Condensing Co.) U. S. Patent 2,449,143. 3 claims. Sept. 14, 1948. Official Gaz. U. S. Pat. Office, **614**, 2: 434. 1948.

Essentially the same as abstract no. 415, except iron and a soluble manganese salt are employed. R. Whitaker

418. Method of improving the yield of riboflavin in fermentation processes. H. L. POLLARD, N. E. RODGERS, AND R. E. MEADE. (Assigned to Western Condensing Co.) U. S. Patent 2,449,142. 4 claims. Sept. 14, 1948. Official Gaz. U. S. Pat. Office, **614**, 2: 434. 1948.

Essentially the same as abstract no. 415, except iron and zinc are employed.

R. Whitaker

419. Production of riboflavin by fermentation processes. H. L. POLLARD, N. E. RODGERS, AND R. E. MEADE. (Assigned to Western Condensing Co.) U. S. Patent 2,449,141. 2 claims. Sept. 14, 1948. Official Gaz. U. S. Pat. Office, **614**, 2: 433. 1948.

Essentially the same as abstract no. 415, except iron and a soluble magnesium salt are employed. R. Whitaker

BUTTER

420. Die Beseitigung des Öl-und Fischgeschmackes der Butter durch pH Regelung. (The removal of oiliness and fishiness in butter by pH regulation.) (English summary.) NIS PETERSEN. Die Milchwissenschaft, **3**, 1: 12–17. 1948.

The authors were unable to correlate the reductase test of milk with oiliness in butter made from the tested milk. Pasture feeding tended to increase incidence of oiliness in butter as compared with feeding hay. Preventive measures against oiliness and fishiness in butter are: (a) mixed feeding ration, (b) high pasteurization temperature, (c) limited washing of butter, (d) low salting of butter, (e) short, rapid working of butter, (f) pH 6–7, (g) protection from light, (h) protection from metal, (i) use of anti-oxidants (wheat germ oil, nordihydroguaiaretic acid, etc.). I. Peters

421. Das Ausölen der Butter. (The oiling-off of butter.) (English summary.) W. MOHR AND K. BAUR. Die Milchwissenschaft, **3**, 1: 17–23. 1948.

The oiling-off of butter was measured at 25 and 28° C. Six cubes of butter (1 cubic inch each) were placed on weighed unhardened filter paper (area 5 to 10 times that of the butter cube) and held at 25 to 28° C. for 48 hours, cooled at 10° C. for 30 minutes and the filter paper re-weighed. Butter held at 28° C. was considered to show low oiling-off if 15% or less fat was absorbed by the paper in 48 hours, whereas a 30% loss or more shows high oiling-off. Factors found to decrease oiling-off were: (a) low melting point of the fat, (b) low air content in butter, (c) use of alfa buttermaker as compared with Fritz or churn buttermaker. I. Peters

422. Das physikalische Bild der Butter. (The physical aspect of butter.) (English summary.) N. KING AND W. FRITZ. Die Milchwissenschaft, **3**, 1: 2–12; **3**, 2: 36–41. 1948.

The authors studied the physical structure of butter microscopically. A known quantity of butter to be examined was stirred into a given volume of butter oil containing 1 to 1.2% octyl alcohol and placed in a counting chamber 0.01 mm. deep, covered with a cover glass and examined under polarized light filtered through a red filter. The fat globules showed a double ring border. Magnification of 400 was used and the temperature of the butter maintained rigidly between 14 to 16° C.

Alfa butter showed the highest per cent of uniform, small, round fat globules with crystals at the border only, whereas machine butter showed larger, slightly flat or irregularly shaped fat globules with crystal formations within the globules. The churn butter took an intermediate position between the alfa and machine butter. The alfa butter had the lowest per cent of free fat and air, followed by the churn and machine butters, respectively.

Butter cubes held at 30° C. for 9 hours and refrigerated over night showed marked difference to cutting resistance. The alfa and machine butter when cut showed a smooth-cut surface, whereas the churn butter was crumbly and difficult to cut. Both the machine and churn butter showed greater melting resistance than did the alfa butter when held at 30° C. I. Peters

423. Production methods and the keeping quality of churning cream. H. R. THORNTON, R. K. SHAW, AND F. W. WOOD. Univ. of Alberta, Edmonton, Can. Sci. Agr., **28**, 9: 377–392. Sept., 1948.

Samples of farm-separated churning cream were collected at 1 creamery and from 2 farms, one producing a high quality cream from machine-drawn milk, while the other ordinarily produced a much lower quality cream. Two additional samples of cream also were secured at the latter farm after the utensils and separator parts had been sterilized. Sub-samples from these were held at temperatures ranging from 40–60° F. for periods up to a month. These

were tested at intervals for off-flavour development, titratable acidity, methylene blue reduction time and bacterial plate count.

Unsterile surfaces with which the cream came in contact, together with storage temperatures above 50° F., were responsible for cream samples dropping from the special grade flavour category. Storage at 50° F. will maintain cream in special grade if delivered twice weekly, while 45° F. storage will maintain this grade for 1 week. The titratable acidity test is of limited value as a means of grading such creams,while the reduction test and bacterial plate count are of no advantage in the routine control of churning creams. Cream may be special grade for churning purposes and yet contain maximum numbers of bacteria.

O. R. Irvine

CHEMISTRY

424. Fosfataseemzymets varmedestruktion. (Destruction of the phosphatase enzyme by heat.) (English summary.) K. P. ANDERSEN, A. M. MADSEN, G. WITTIG, AND H. FAXHOLM. 57. Beretning fra Statens Forsøgsmejeri., Hillerød, Denmark. 1948.

A method for the determination of the laws which govern the effect of heat and time on the phosphatase enzyme was worked out.

A small glass ampule was used for the pasteurization of 1 ml. of milk. The ampule was 100 mm. high, of which 50 mm. was neck. The outside diameter of the neck was 5.0 mm., of the lower part 19 to 20 mm. The thickness of the glass wall was 0.5 mm. The heat conductivity of the glass ampule was 0.026. Heating of 1 ml. of milk 20° C. ± 0.1° C. would take a calculated 17.1 sec., making it impossible to use direct heat at temperatures so high that the time of destruction would be shorter than time of heating. The cooling of 1 ml. milk from 80 to 60° C. was calculated to take 0.94 sec. in ice water. The destruction of the phosphatase enzyme in this time and at the corresponding temperatures is very insignificant.

These calculations showed it impossible to state the pasteurization time at high temperatures by heat transmission. To overcome this, part of the milk, in which the phosphatase enzyme already was destroyed, was heated to such a temperature that addition of the rest of the milk would bring the temperature down to pasteurization temperature. By churning of raw cream, a buttermilk with a phosphatase activity of 5–6 times that of raw milk was obtained, and this was used where dilution was necessary. The difference in destruction of the phosphatase enzyme in the concentrate and in the corresponding milk was not greater than between 2 different samples of raw milk. The enzyme concentrate was preserved with 1% potassium dichromate in order to carry the whole experiment out with the same concentrate. The preservative caused only a slightly faster destruction of the enzyme as compared to normal milk.

The technic for pasteurizing the milk was that 0.75 ml. of pasteurized milk was preheated to a temperature such that injection of 0.25 ml. of enzyme concentrate at 37° C. would bring the mixture down to the desired holding tem-

perature, following which it was transferred quickly to a water bath of desired temperature and when time was out transferred quickly to ice water. The method was used between 60–80° C. All transfers were made as fast as possible (0.3 sec.). Where the time of destruction was shorter than 1 sec., the transfer to a holding bath was left out.

The speed of reaction of the enzyme was determined at constant temperature ranging from 60–80° C. The results obtained showed that destruction of the phosphatase enzyme is not a first order reaction. The phosphatase enzyme has an optimum stability at its natural pH, compared to pH 6.2 and 7.4. The increase in rate of destruction caused by increase in temperature is found to be in agreement with Arrhenius' formula. Calculations showed that for 5° C. increase in temperature the increase of destruction was 10 times as great, which was in good agreement with results found experimentally. From the results obtained, the time of destruction can be calculated for any pasteurization method. T. Kristoffersen

425. Trace sugars in milk. C. P. Anantakrishnam and B. L. Herrington. Dept. Dairy Industry, Cornell Univ., Ithaca, N. Y. Arch. Biochem., **18**, 2: 327–337. 1948.

By means of fractional crystallization, glucose was isolated from dialyzed, de-ionized milk serum. It constitutes the whole of the monoses in milk, and exists in the free state to the extent of 4.08 to 7.58 mg./100 ml. of milk (10 samples). Colostrum milk contains more glucose than normal milk. Immediately after calving, the colostrum of a Holstein cow contained 15 mg. glucose per 100 ml. colostrum, that of a Jersey 12.5 mg./100 ml. The Holstein reached a normal glucose value in 3 days, the Jersey in 10 days after parturition. H. J. Peppler

426. Some effects of feeding synthetic thyroprotein to dairy cows. C. E. Allen, Dorothy S. Dow, V. S. Logan, and C. D. MacKenzie. Cent. Exptl. Farm, Ottawa, Can. Sci. Agr., **28**, 8: 340–356. Aug., 1948.

In a 3-month trial, a synthetic thyroprotein, ''Protomone'', containing 3.07% thyroxine by analysis was fed to 3 Holstein and 3 Ayrshire cows at the rate of 15 g. daily for 6 weeks and the effects compared to paired controls. The results include data on the 2-week period preceding treatment and the 4-week period after treatment was completed. Increased milk production occurred in the early part of treatment, the maximum individual increase over the pre-treatment period being 16.7%. All cows, with one exception, declined rapidly subsequent to treatment. Fat tests were increased by from 0.4 to 1.4%, but no significant changes occurred in lactose, total nitrogen, ash or solids-not-fat percentages. Milk yields calculated on a 4% fat basis showed marked increases, the maximum being 41.2%. Body weight losses varying from 7.1 to 13.7% were observed in all cows treated despite the addition of 2 lb. of extra meal per cow per day. Pulse rates were markedly higher for the treatment period but declined after treatment to less than the control animals. No other evidence of ill-health was evident, however.

The need for longer term investigations of the effect of thyroprotein on dairy cattle is apparent before use of this substance can be recommended. The necessity for its strict control to prevent dishonest production records also is pointed out. O. R. Irvine

427. Choline content of live stock feeds used in western Canada. L. W. McElroy, H. A. Rigney, and H. H. Draper. Univ. of Alberta, Edmonton, Can. Sci. Agr., **28**, 6: 268–271. June, 1948.

The choline content of a number of feeds of different types was found by preparing a solution of extracted choline reineckate in acetone and determining the amount present in an Evelyn photo-electric colorimeter, using filter no. 515. Samples of grain, hay, by-products and commercial poultry feeds were examined and the results recorded. Oats and barley exceeded wheat and corn as sources of choline. Legume hays were found to be better sources than grass hays and the choline content was higher in leafy good coloured samples. Buttermilk powder and whey powder gave values consideraby greater than skim milk powder. O. R. Irvine

FOOD VALUE OF DAIRY PRODUCTS

428. Discussion on unidentified nutrient. C. A. Cary and A. M. Hartman. U. S. Dept. of Agr. Certified Milk, **23**, 9: 6–9. Sept., 1948.

The existence of an unidentified nutrient X was demonstrated by the improvement in growth of rats when certain feeds were fed in or with the basal ration. In general, the nutrient X was found in leafy foods, liver, beef and pork muscle, egg yolk, whole milk, skim milk, non-fat solids of milk, cheese, crude casein from milk and all milk products containing the crude proteins of milk. It was not found in cereal grains, cereal grain products, yeast and yeast products. Experiments also showed that X may be synthesized by bacteria in the rat. However, the rat's requirement must be supplied in the diet because the synthesis by bacteria occurred only under extraordinary conditions and, therefore, is undependable. W. S. Mueller

ICE CREAM

429. Ice cream dipper. M. F. Costa. (Assigned to T. N. Benedict Mfg. Co.) U. S. Patent 2,448,863. 1 claim. Sept. 7, 1948. Official Gaz. U. S. Pat. Office, **614**, 1: 225. 1948.

An ice cream dipper having a semi-spherical bowl and a scraper blade for discharging the ice cream is described. R. Whitaker

430. Frozen food container. C. R. Symmes. (Assigned to H. P. Hood and Sons, Inc.) U. S. Patent 2,444,861. 3 claims. July 6, 1948. Official Gaz. U. S. Pat. Office, **612**, 1: 248. 1948.

Ice cream and other frozen foods are frozen in a lined cylindrical carton which is so constructed that the product, surrounded by the liner, may be ejected from the container by upward pressure on the bottom. Peeling of the liner is facilitated by tabs on each side of a lengthwise slit in the liner. R. Whitaker

MILK

431. Suspending agent for beverages. K. W. KARNOOP. (Assigned to Kalva Corp.) U. S. Patent 2,448, 599. 8 claims. Sept. 7, 1948. Official Gaz. U. S. Pat. Office, **614**, 1: 162. 1948.

A water soluble extract of Iridophycus is suitable as a stabilizer for chocolate flavored beverages, such as chocolate milk. R. Whitaker

MISCELLANEOUS

432. Cream whipper. E. C. BRULL. U. S. Patent 2,444,897. 1 claim. July 6, 1948. Official Gaz. U. S. Pat. Office, **612**, 1: 256. 1948.

The ends of 2 rectangular thin flat sheets of bendable metal are fastened together to form an ellipse in side elevation. This dasher is caused to rotate rapidly by means of a vertical shaft through the center. R Whitaker

433. Milking machine. A. C. BLOEMERS. U. S. Patent 2,445, 904. 7 claims. July 27, 1948. Official Gaz. U. S. Pat. Office, **612**, 4: 960. 1948.

A milking machine which has individual control of the vacuum on each teat cup is described. R. Whitaker

434. Milk can drying rack. E. P. SWINTOSKY. U. S. Patent 2,449,628. 1 claim. Sept. 21, 1948. Official Gaz. U. S. Pat. Office, **614**, 3: 698. 1948.

A simple angle iron rack for holding lids and milk cans in an inverted position to facilitate drying after cleaning is described. R. Whitaker

435. Milk can strainer accommodating attachment. P. P. HANSON. U. S. Patent 2,450,510. 3 claims. Oct. 5, 1948. Official Gaz. U. S. Pat. Office, **615**, 1: 147. 1948.

A rubber gasket is described which fits on milk cans for holding a conventional type milk strainer. Channels between V shaped ribs permit escape of air from the can. R. Whitaker

436. Liquid temperaturizing vat. F. J. MCCULLOUGH. U. S. Patent 2,446,054. 4 claims. July 27, 1948. Official Gaz. U. S. Pat.Office, **612**, 4: 999. 1948.

A cylindrical pasteurizing vat for dairy products which provides a built-in heating or cooling device is described. A pump circulates the heating or cooling medium from a sump tank spirally upward between 2 walls containing heating or cooling coils and surrounding the vat. On reaching the top, the medium is sprayed inward against the wall of the vat where it flows downward to the sump to be recirculated. R. Whitaker

AUTHOR INDEX OF ABSTRACTS

ADAMS, D. S., where the milk dollar goes, A23

ALEXANDER, F. M., milk bottle closure, A149

ALHEIT, H. A., ice cream dispensing device, A157

ALLEN, C. E., feeding cows synthetic thyroprotein, A164

AMERICAN PUBLIC HEALTH ASSOCIATION, Standard Methods for the Examination of Dairy Products, 9th edn., A151

ANANTAKRISHNAN, C. P., glycerides of milk fat, A146; trace sugars in milk, A164

ANDERSEN, K. P., phosphatase destruction by heat, A163

ANDERSON, E, P., milk rations and dental caries, A100

ANDERSON, L. C., ice cream cabinet and truck space, A83

ANGEVINE, N. C., sweet curd cottage cheese, A17

ANGULO, J. J., vitamin A of Cuban milk, A155

ANONYMOUS, cheese and its relation to disease, A7; control of vitamin D milk, A21; automatic ice cream packaging, A35; ice cream in grocery stores, A36; equipment sales to farmers, A40; training for foremen and supervisors, A41; making an economical dairy ration, A49; billboard advertising for ice cream, A68; labor costs in ice cream outlets, A68; butterfat content in ice cream for 1947, A80; ice cream cabinets, A83; sherbets, A83; ice cream delivery, A84; ice cream merchandising, A85; 1947 ice cream gallonage, A86; 3-day-a-week milk delivery, A88; state locker laws and regulations, A92; ice cream buying habits, A101; ice cream pricing, A102; a consumer taste-test panel, A122; ice cream sale by weight, A123; trend toward converting boilers to oil or gas, A129; ice cream and tooth decay, A134; price trends for ice cream, A137; retail prices for ice cream, A137; oblong 2-quart bottle, A138; conversion to oil fuel continues, A144; foreign fats in ice cream, A148; special ice cream package, A148

ARMSTRONG, T. V., cleaning of square vs. round milk bottles, A57

ASHESHOV, I. N., antibiotics active against bacterial viruses, A160

ASHWORTH, U. S., estimating baking quality of milk proteins, A9

ATKINSON, IDA, preparing peaches for freezing, A91

BAILEY, M. S., cleaning equipment, A141

BAIN, J. A., lactoglobulin studies, A76; correcting defects in Canadian cheese, A112

BAKER, M. P., dairy sanitation, A89

BARALT, J., Lancefield group "B" streptococci from human sources, A93

BARKER, E. M., improving milk quality, A69

BARNETT, G., *Staphylococcus aureus* in pastry fillings, A4

BARON, M., rheological experiments on Gruyere, A30

BARRETT, A., microbial differentiation of casein and lactalbumin, A31

BARTLETT, H. J., check valves, A107

BATHURST, N. O., thiamine, riboflavin and niacin in milk, A8

BAUMAN, J. N., selection and applications of trucks, A25

BAUR, K., oiling-off of butter, A162

BAYER, A. H., control of raw materials and partly finished products in the ice cream plant, A50

BEAL, GRACE A., brucella agglutination tests and cholera vaccination, A19

BEENIE, A. K., water treatment, A91

BENDER, C. B., effect of trace elements on the metabolism of calcium and phosphorus, A48

BENDER, L. F., milking apparatus, A11

BENDIXEN, H. A., ice cream shrinkage, A81; ice cream shrinkage, A119

BENNETT, F. W., new flavors for ice cream, A135

BENNETT, H., practical emulsions, A1

BERCH, S. H., ice cream carton, A148

BERGMAN, RAGNAR E., sampling and analysis of condensed buttermilk, A65

BERGMAN, D. T., brucellosis discussion, A47

BERRY, A. E., farm inspection for better milk, A126

BHALERAO, V. R., glycerides of milk fat, A146

BINNEY, T. M., fat variation in milk tests, A54

BITTERS, HARRY, hardening ice cream, A120

BLACK, L. A., staining procedures for direct

microscopic examination of milk, A109; staining formulas for direct microscopic examination of milk, A152
BLAIR, W. S., rheological experiments on Gruyere, A30
BLOEMER, A. C., milking machine, A166
BLUMENTHAL, SAUL, food products, A2
BOGAERTS, P. J., can washing, A126
BOLEY, L. E., thiamine deficiency in the calf, A49
BORTREE, A. L., separator cleanliness, storage temperature and cream quality, A44
BOURDILLON, J., crystalline pepsin-resistant protein from skeletal muscle, A65
BOWSTEAD, J. E., urea feeding, A97
BOYD, W. L., expulsion of fetal membranes, A146
BREAZEALE, D. F., off-flavors in market milk, A86
BRIGHTMAN, M. H., greater milk production, A103
BRIMBLECOMBE, V. J., butter defects, A74
BROOKS, R. F., field test for quaternary ammonium germicides, A127
BROWN, C. F., growth-promoting activity of vaccenic acid, A79
BROWN, HELEN J., microlysine-tear gas preserves milk, A110
BROWN, R. W., controlling butter composition, A61; pasteurizing milk for cheesemaking, A111; control of cheese mites, A113
BRULL, E. O., cream whipper, A166
BRYANT, C. B. A., sediment from milking machine suction cups, A88
BRYANT, L. R., retention of minerals and vitamins in cheesemaking, A113; water treatment, A128
BUCHBINDER, L., enterococcal food poisoning, A116
BUDAN, H. W., milk bottle cap, A71
BUEHLER, L., JR., refrigeration for the milk bottling plant, A56
BURGWALD, L. H., keeping quality of pasteurized milk, A54; cleaning of square vs. round milk bottles, A57
BURKEY, L. A., making kefir fermented milk, A9; kefir fermented milk, A78
BURKHART, R. L., penicillin blood and milk concentrations, A157
BUSTAD, L. K., synthetic milk for raising pigs, A134

CAIRY, C. F., problems of hormone treatments, A39
CAMPBELL, B. L., prospective milk production and consumption in Canada, A126
CAMPBELL, I. L., thiamine, riboflavin and niacin in milk, A8
CAMUS, A., isolation of aroma-producing ferments of butter, A28
CARY, C. A., unidentified nutrient in milk, A165
CASALIS, J., "blue" defect of soft, mold-cured cheese, A94; whey separation in kefir, A96
CASLER, H. L., emulsifiers for ice cream, A118
CATHCART, W. H., *Staphylococcus aureus* in pastry fillings, A4
CECIL, S. R., preparing peaches for freezing, A91
CHANG, M. C., fertilizing capacity of rabbit spermatozoa, A94
CHAPMAN, R. A., keeping quality of dried milk powder, A116
CHELDELIN, V. H., microbiological assay for riboflavin, A44
CLABORN, H. V., lactic and succinic acids in foods, A63
CLARK, A. M., physiological action of sodium carboxymethylcellulose, A158
CLIFTON, C. E., editor, Annual Review of Microbiology, Vol. I, A43
COLLINS, W. F., ice cream stabilizers, A66
CONNELL, W. E., vitamin A intake in cattle, A10
CONOCHIE, J., oxidant effects of salt and water in butterfat, A9
COOK, A., retention of minerals and vitamins in cheesemaking, A113
COOK, J. H., determination of iron in foods, A8
COOK, W. H., value of research, A129
CORDES, W. A., homogenizing milk, A69
COSTA, M. F., ice cream dipper, A165
COURTNEY, J. L., variability in standard plate counts, A73
COWLEY, R. F., vitamin A of Cuban milk, A155
CRABB, R. C., proper store differentials for milk, A53
CRANFIELD, JOYCE, bacteriology of ice cream, A152
CUNHA, T. J., synthetic milk for raising pigs, A134

CUNKELMAN, J. W., breeding unsoundness in cows, A65
CUNNINGHAM, L. C., technical considerations in leveling milk production, A55
CURME, H. G., thermodynamics of metallo-protein combinations, A76
CURRAN, H. R., esters of vanillic acid as spore-controlling agents, A153

DAHLBERG, A. C., nutritive value of ice cream, A99
DAHLE, C. D., shrinkage in ice cream, A33; ice cream stabilizers, A66
DALRYMPLE, D. B. H., supplementary vitamins for calves, A65
DAMROW, E. C., starters for cheese, A112; increasing yield in cheesemaking, A112
DANIEL, F. K., fractionation of lacteal liquids, A100
DAUBERT, B. F., configuration of vaccenic acid, A75
DAVIDSON, F. R., milk products in bread making, A77
DAVIDSON, W. M., iodized rock salt, A98; nutritive ratio and digestibility, A98
DAVIES, J. C., rinses and swabs of farm dairy utensils, A39
DAVIES, O. L., statistical evaluation of growth curves, A106
DEAN, D., delivery of single service container, A70
DEARDORFF, C. E., cream separator, A45; fiberboard cream-separating milk container, A71
DEATH, G. C., copper estimation in cream, A8
DECKER, G. C., insect and rodent control, A40
DELAY, P. D., coliform test on pasteurized milk, A12
DEUEL, H. J., JR., growth-promoting activity of vaccenic acid, A79
DEUTSCH, H. F., gamma globulins of normal bovine sera, A64; lactoglobulin studies, A76
DOAN, F. J., modified microscopic method for bacteria in milk, A2; frozen storage of milk, A137
DOBSON, W. D., ice cream cabinets, A83
DOLBY, R. M., control of cheese mites, A7
DOLPHIN, J. L., ice cream trends, A123
DOW, DOROTHY S., feeding cows synthetic thyroprotein, A164
DRAPER, H. H., choline content of feeds, A165
DRELL, WILLIAM, analogs of pantothenic acid as inhibitors of bacteria, A132
DUMAIS, R., extraneous matter in Cheddar cheese, A113
DUNCAN, C. W., method of investigating chemical changes in the rumen, A47; chemistry of rumen digestion, A48
DUGGAN, R. E., free tryptophane in milk, cream and butter, A63
DUNLAP, H. G., liquid sugar in ice cream, A52
DUNN, M. S., analogs of pantothenic acid as inhibitors of bacteria, A132
DUTHEN, JEANNE, "blue" defect of soft, mold-cured cheese, A94

EARLE, I. P., bovine edema due to vitamin A deficiency, A50
EISELE, C. W., brucella agglutination tests and cholera vaccination, A19
ELLIS, C. F., brine freezing strawberries, A91
ELVEHJEM, C. A., milk rations and dental caries, A100
EMMONS, C. W., Henrici's Molds, Yeasts and Actinomycetes, A1
ERB, J. H., improving packaged ice cream, A34; dairy plant housekeeping, A105
EREKSON, A. B., payments for high fat Cheddar cheese, A6
EVANS, E. V., retention of minerals and vitamins in cheesemaking, A113
EVANS, F. R., esters of vanillic acid as spore-controlling agents, A153
EVANS, T. C., radioautographs of tissue, A107

FAIR, J. L., sterilizing arrangement for milk tubes, A149
FARRAG, H. F., penicillin action on mastitis organisms, A74
FAXHOLM, H., phosphatase destruction by heat, A163
FERGUSON, L. C., blood groups of cattle, A24; staphylococcic abortion in a dairy herd, A32
FINE, C., stock watering tank, A11
FINLEY, R. D., germicidal efficiency of can washing compounds, A13; corrosion of tin plate by can washing compounds, A14
FLANAGAN, T. L., determination of quaternary ammonium compounds, A18
FORBES, BENJAMIN P., chocolate milk drink, A139
FOTER, M. J., germicidal efficiency of can washing compounds, A13; corrosion of tin plate by can washing compounds, A14

Fox, S. W., bacterial activity of "racemized casein", A154
Frary, G. G., serum methods for added water in milk, A63
Fredeen, H. T., urea feeding, A97
Frey, P. H., vitamin A intake in cattle, A10
Fritz, W., structure of butter, A162
Fritzsche, H. W., browning reaction involving copper-proteins, A146
Frost, J. N., hereditary epithelial defects, A145
Fuentes, Cesar, vitamin A of Cuban milk, A155

Garrett, O. F., ionic exchanges, A76
Geiger, A. A., refrigeration for dairy plants, A141
George, J. S., cleaning and sterilizing equipment, A127
Getz, C. A., cream whipping by aeration, A77
Ghormley, D., retail store for ice cream, A82; retail store for ice cream, A101; ice cream retail store, A136; retail store for ice cream, A149
Giannotti, D., vitamins B and fat production, A97
Gibbons, N. E., microlysine-tear gas preserves milk, A110
Gibson, A. L., nutritional value of cheese, A117
Gibson, C. A., openness in Cheddar cheese, A112
Gibson, G. G., cream bodying, A87
Gilmour, D., toxicity to houseflies of paints containing DDT, A14
Glaser, Irene, "blue" defect of soft, mold-cured cheese, A94; whey separation in kefir, A96
Glazier, O. H., planning retail drive-in ice cream stores, A36
Godkin, W. J., *Staphylococcus aureus* in pastry fillings, A4
Gooding, C. M., growth promoting activity of vaccenic acid, A79
Gould, I. A., lactic acid content as indicator of ice cream quality, A52
Grant, G. A., fluorescence method for assessing keeping quality of butter, A29
Greenberg, S. M., growth-promoting activity of vaccenic acid, A79
Griffith, W., ice cream merchandising, A119

Hackman, A. L., the bulk gallon of ice cream, A35
Hackman, R. H., persistence of DDT on cattle, A11
Hager, O. B., determination of quaternary ammonium compounds, A18
Hale, E. B., method of investigating chemical changes in the rumen, A47; chemistry of rumen digestion, A48
Hall, Elizabeth, antibiotics active against bacterial viruses, A160
Hall, S. R., inanition and mammary-gland development, A128
Hamilton, T. S., thiamine deficiency in the calf, A49
Hammer, B. W., Dairy Bacteriology, A109
Hams, W. E., synthetic milk for raising pigs, A134
Hanrahan, F. P., heat exchanger for milk, A149
Hanson, P. P., milk can strainer-accommodating gasket, A166
Hantz, J. J., electrical system for cattle stalls, A12
Harland, H. A., estimating baking quality of milk proteins, A9
Hartman, A. M., unidentified nutrient in milk, A165
Hazlewood, B. P., all-year pasture, A147
Health, J. H., quality control program, A90
Heftmann, E., nutritive value of butter fatty acids, A10
Heilbron, Ian, vitamin A developments, A133
Herman, H. A., The Artificial Insemination of Dairy Cattle. A Handbook and Laboratory Manual, A151
Herman, R. C., apparatus for washing milking machines, A150
Herrick, A. D., Food Regulation and Compliance, A27
Herrington, B. L., trace sugars in milk, A164
Hess, E. L., gamma globulins of normal bovine sera, A64
Hilditch, T. P., structure of unsaturated higher fatty acids, A133
Hills, G. L., ferric thiocyanate method for peroxide, A8; oxidant effects of salt and water in butterfat, A9; Babcock test, A75
Hinshaw, E. B., growth of rats as affected by treatment of milk fat, A50
Hipp, N. J., combination of formaldehyde with casein, A115

HIPPLE, T. B., powdered ice cream mix, A38
HLYNKA, I., discoloration in malted process cheese, A155
HOBSON, P. M., rinses and swabs of farm dairy utensils, A39
HODGES, H. C., research and control of mastitis in N. Y. state, A46
HODGSON, R. E., more milk from forage crops, A49
HOLLER, E. M., refrigerator car with absorption ammonia system, A41
HOOD, E. G., determining extraneous matter in Cheddar cheese, A62; openness in Cheddar cheese, A112; research on Cheddar cheese quality, A114; discoloration in malted process cheese, A155
HORWITZ, W., detecting sodium neutralized nonfat dry milk solids, A63; fat and moisture in cheese, A114
HOVEY, V. F., ice cream costs and profits, A37
HUBBLE, C. T., federal food and drug requirements, A40
HUCKER, G. F., field test for quaternary ammonium germicides, A127
HUFFMAN, C. F., method of investigating chemical changes in the rumen, A47; chemistry of rumen digestion, A48
HUGHES, J. S., determination of vitamin A and carotenoids, A116
HULSE, J. B., frozen foods transportation, A92
HUSSONG, R. V., quaternary ammonium germicides, A40; micro-organisms in defective milk products, A110
HUTT, F. B., hereditary epithelial defects, A145

IRVINE, O. R., retention of minerals and vitamins in cheesemaking, A113

JACK, E. L., growth of rats as affected by treatment of milk fat, A50
JACKSON, H. S., retention of minerals and vitamins in cheesemaking, A113
JACKSON, R. W., combination of formaldehyde with casein, A115
JACOBSON, D. H., bottle washing, A126
JENSEN, J. M., separator cleanliness, storage temperature and cream quality, A4
JENSEN, R., vitamin A intake in cattle, A10
JOHNS, C. K., practical training for dairy technologists, A41; quaternary ammonium and hypochlorite solutions for sanitizing, A127
JOHNSON, B. C., thiamine deficiency in the calf, A49
JOHNSTONE, W. M., retention of minerals and vitamins in cheesemaking, A113
JONES, C. G., rinses and swabs of farm dairy utensils, A39
JONES, ROBERT E., biography of Chester Earl Gray, A73
JONES-EVANS, E., rinses and swabs of farm dairy utensils, A39
JORDAN, C. F., brucellosis in industry, A156
JOSEPHSON, D. V., evaluating flavor of ice cream, A51; keeping quality of pasteurized milk, A54; evaluating ice cream flavor, A121
JUE, DOROTHY, growth-promoting activity of vaccenic acid, A79
JULIEN, J. P., extraneous matter in Cheddar cheese, A113

KARNOOP, K. W., suspending agent for beverages, A166
KAUFMAN, D. L., liquid cooling unit, A23
KEENAN, J., milking machine care, A89
KEILLING, JEAN, isolation of aroma-producing ferments of butter, A28; microbial differentiation of casein and lactalbumin, A31; "blue" defect of soft, mold-cured cheese, A94; whey separation in kefir, A96
KELSER, RAYMOND A., Manual of Veterinary Bacteriology, A131
KENNEDY, J. W., nutritive ratio and digestibility, A98
KIESEL, G. K., treatment of pneumonia in cattle, A32
KING, N., structure of butter, A162
KINTNER, E. K., pasteurizing apparatus, A15
KLOTZ, I. M., binding of sulfonamides, A76; thermodynamics of metallo-protein combinations, A76
KNOOP, C. E., staphylococcic abortion in a dairy herd, A32
KNUDSEN, LILLA, fat and moisture in cheese, A114
KOBAYASHI, Y., bacterial activity of "racemized casein", A154
KOCHER, R. B., browning reaction involving copper-protein, A146
KOKES, ELSIE L., combination of formaldehyde with casein, A115
KORNBERG, H. A., microbiological assay for riboflavin, A44

KRAMER, B., administration of vitamin A in oily and in aqueous media, A50
KRAUSS, W. E., staphylococcic abortion in a dairy herd, A32
KRIENKE, W. A., frozen whole milk, A20
KURZROK, R., follicle cell dispersal in rat ova, A93

LANGDON, R. S., microbiological assay for riboflavin, A44
LANGER, P. H., penicillin blood and milk concentrations, A157
LARSEN, N. C., vanilla, A34
LAWRENCE, J. W., ice cream as food, A35
LEEDER, J. A., ice cream shrinkage, A82
LEGLOAHEC, V. C. E., algin stabilizer, A157
LEMON, J. M., fish in the freezer, A92
LEONARD, S. L., follicle cell dispersal in rat ova, A93
LEVINE, B. S., staining procedures for direct microscopic examination of milk, A109; staining for direct microscopic examination of milk, A152
LEVITON, A., ice cream mix, A67
LICHTBLAU, JACQUELINE, administration of vitamin A in oily and aqueous media, A50
LIGHTFOOT, F. RUTH, copper estimation in cream, A8
LITTLE, L. L., review of can-washing literature, A88; emulsifiers and stabilizers for ice cream, A117; cottage cheese, A155
LOGAN, V. S., feeding cows synthetic thyroprotein, A164
LONGSWORTH, L. G., specific refractive increment of proteins, A156
LOOSLI, J. K., supplementary vitamins for calves, A65; nutritive value of ice cream, A99
LUCK, J. MURRAY, editor, Annual Review of Biochemistry, vol. I, A17

MACDONALD, F. J., freezing point of milk, A38
MACKENZIE, C. A., feeding cows synthetic thyroprotein, A164
MACKENZIE, C. D., quality milk production, A125
MACLEAN, A. R. M., milk quality control, A110
MADDEN, F. W., The Artificial Insemination of Dairy Cattle. A Handbook and Laboratory Manual, A151
MADSEN, A. M., phosphatase destruction by heat, A163
MADSEN, L. L., bovine edema due to vitamin A deficiency, A50
MAIRERO, ALBERTO, vitamin A of Cuban milk, A155
MANGOLD, E. F., portable milk pasteurizing apparatus, A71
MARKLEY, KLARE S., fatty acids, their chemistry and physical properties, A17
MARQUIS, T. V., manufacture of milk sugar, A146
MARTIN, W. H., new developments in refrigeration, A130
MASSON, G. M. C., gonadotrophic hormones and lactation, A104
MAUGHAN, M. O., cottage cheese from nonfat dry milk solids, A46
MCAULIFFE, H., ice cream laboratory, A81
MCCANCE, R. A., chemical composition of Foods, A1
MCCULLOUGH, F. J., pasteurizing vat, A166
MCCULLOUGH, N. B., brucella agglutination tests and cholera vaccination, A19
MCDOWALL, F. H., controlling moisture content of butter, A4; cream neutralization, A4; land-cress taint of butter, A5; land-cress feeding and taint in cream and butter, A5; thiamine, riboflavin and niacin in milk, A8; utilization of buttermilk in New Zealand, A9
MCDOWELL, A. K. R., land-cress taint of butter, A5
MCELROY, L. W., choline content of feeds, A165
MCFADDEN, J. B., apparatus for homogenization, A129
MCLEOD, W. S., control of cheese mites, A113
MCQUARRIE, I., meat and milk as sources of calcium, phosphorus and protein, A99
MEADE, R. E., fermentative production of riboflavin, A28; riboflavin from whey and skim milk, A28; riboflavin from lacteal material, A29; iron and magnesium in riboflavin production, A161; iron and zinc in riboflavin production, A161; iron and manganese in vitamin concentrate, A161; enhancing vitamin yield in fermentation, A161; vitamin concentrate from whey, A160
MEHLENBACHER, V. C., determination of iron in foods, A8
MEISER, J. A., JR., shrinkage in ice cream, A33
MEITES, J., sex hormones and pituitary lactogen, A104; thiouracil and estrogen administration to rats, A104

MELVIN, S., bacterial activity of "racemized casein," A154
MERORY, J., evaluation of vanilla, A79
MEURON, H. J., preparation of butter samples, A111
MINARD, F. N., bacterial activity of "racemized casein," A154
MINOR, LEE H., testing equipment as aid to sanitation, A128
MINTHORN, C. M., H.T.S.T. pasteurization of ice cream mix, A80; A119
MISNER, E. G., production of different dairy breeds, A11
MITCHELL, D. J., serum methods for added water in milk, A63
MOCQUOT, G., rheological experiments on Gruyere, A30; bound water of cheeses, A94
MOHR, W., oiling-off of butter, A162
MOIR, G. M., copper estimation in cream, A8
MOORE, A. V., phosphatase test for homogenized milk, A55
MOORE, C. M., cleaning bottles, A24
MOORE, G. R., causes and diagnosis of infertility in bulls, A29
MOORE, I. H., meat and milk as sources of calcium, phosphorus and protein, A99
MORALES-OTERO, P., Lancefield group "B" streptococci from human sources, A93
MOREAU, R., analysis of cream, A31
MORELAND, F. B., residual chlorine in milk, A64
MORTON, I. D., land-cress feeding and taint in cream and butter, A5; land-cress taint of butter, A5
MORWICK, E. I., ultraviolet radiation in dairy industry, A110
MOSS, C. M., time factor in H.T.S.T. pasteurizing, A124
MUGGERIDGE, J., control of cheese mites, A7
MUIR, G. W., nutritive ratio and digestibility, A98
MULDOON, H. J., drive-in ice cream outlets, A36
MUNROE, T. G., stick novelties operation, A122
MURDOCK, H. E., rack for milk strainers, A158
MURGUIA, L. J., milk preservation with chemicals, A12
MUSHER, S., frozen dessert composition, A38

NELSON, W. O., microorganisms in defective milk products, A110
NESMITH, J. C., labor control in ice cream processing, A81
NEVENS, W. B., thiamine deficiency in the calf, A49
NEWMAN, P. E., vitamin A and trace minerals for dairy cattle, A66
NORD, F. F., editor, Advances in Enzymology, Vol. VII, A43; Vol. VIII, A131
NORTH, G. C., cottage cheese, A155
NORTON, C. L., supplementary vitamins for calves, A65

OBEE, C. G., creamery fat losses, A111
O'DEA, J. J., land-cress feeding and taint in cream and butter, A5
OLSON, J. C., JR., groups of bacteria, A74
OSLER, A. G., enterococcal food poisoning, A116

PALMER, F. D., paper bottle design, A56
PARRISH, D. B., determination of vitamin A and carotenoids, A116
PASCOE, J. V., H.T.S.T. pasteurizer timing, A87; H.T.S.T. pasteurizer, A87
PATTERSON, W. I., lactic and succinic acids in foods, A63
PAUL, T. M., glycerides of milk fat, A146
PEARCE, J. A., Fritz butter machine, A110
PEARSON, P. B., riboflavin ingestion and amount in milk and urine, A9
PEBBLES, D. D., manufacture of milk sugar, A146
PEDERSON, M. G., sanitary practices, A140
PERLMAN, P. L., follicle cell dispersal in rat ova, A93
PERLMANN, G. E., specific refractive increment of proteins, A156
PERRIN, D. D., polarographic estimation of ascorbic acid, A8
PERRIN, DAWN R., polarographic estimation of ascorbic acid, A8
PETERSEN, NIS, pH regulation for butter, A161
PFAU, K. O., effect of trace elements on the metabolism of calcium and phosphorus, A48
PFEFFER, J. C., packaged ice cream, A85
PFETCHER, T. J., cover and filter for milker pails, A149
PHILLIPS, P. H., milk rations and dental caries, A100
PIEN, J., chloropicrin for milk preservation, A159
POHLE, W. D., determination of iron in foods, A8

POLLARD, H. L., fermentative production of riboflavin, A28; riboflavin from whey and skim milk, A28; riboflavin from lacteal material, A29; vitamin concentrate from whey, A160; enhancing vitamin yield in fermentation, A161; iron and manganese in vitamin production, A161; iron and zinc in riboflavin production, A161; iron and magnesium in riboflavin production, A161
POMALES-LEBRON, A., Lancefield group "B" streptococci from human sources, A93
PONT, E. G., effect of butter washing on curd content and quality, A5
PORK, W. J., Gouda cheese, A75
POST, J. W., employer-employee relationships, A90; employer-employee relationships, A142
POTTER, F. A., lactic acid content as indicator of ice cream quality, A52
POUNDEN, W. D., staphylococcic abortion in a dairy herd, A32
PRADINES, N., inhibitory action of pyocyanim against *Brucella* sp., A3
PUNDERSON, J. M., outlook for cream and milk solids in 1948, A67

QUIGLEY, J. V., homogenizing milk, A69
QUITTER, H. A., building "dry stop" volume, A53

RABUFFO, V. M., price trends in ice cream, A86; dealers profits in dipping bulk ice cream, A157
RAO, P. C., configuration of vaccenic acid, A75
REAGIN, J. H., brine tank for frozen confections, A149
REIBEIRO, J. A., ferments for cheese, A6
REID, J. T., effect of calcium, manganese and other trace elements on the metabolism of lipids, A48; effect of trace elements on the metabolism of calcium and phosphorus, A48; manganese metabolism in cattle, A116; mineral supplementation and blood composition, A147
REID, W. H. E., cottage cheese from nonfat dry milk solids, A46
REINEKE, E. P., feeding thyroprotein and thiouracil, A99
REMALEY, R. J., dry milkfat for storage, A96, A134; concentrated and dry ice cream mixes, A135
RESURGGAN, J. C. L., surface chemistry and physics of detergency, A39
RIBEIRO, J. A., direct steam pasteurization, A6
RICE, T. B., brucellosis as an occupational disease, A19
RIGNEY, H. A., choline content of feeds, A165
ROBERTS, S. J., treatment of pneumonia in cattle, A32
ROBINSON, C. H., nutritive ratio and digestibility, A98
ROBINSON, H. B., time factor in H.T.S.T. pasteurizing, A124
RODENKIRCHEN, J., acetoin and diacetyl in butter cultures, A61
RODGERS, N. E., fermentative production of riboflavin, A28; riboflavin from whey and skim milk, A28; riboflavin from lacteal material, A29; vitamin concentrate from whey, A160; enhancing vitamin yield in fermentation, A161; iron and manganese in vitamin production, A161; iron and zinc in riboflavin production, A161; iron and magnesium in riboflavin production, A161
ROJAS, F. A., inorganic calcium and phosphorus of cow blood, A13
ROSEBRUGH, C. F., losing money in the milk business, A70
ROTTSCHAEFER, W., brucella agglutination tests and cholera vaccination, A19
RUDNICK, A. W., sediment testing of cream, A44
RUPPRIGHT, S., defrosting, A34

SADTLER, S. S., powdered ice cream mix, A38
SAHYUN, M., Proteins and Amino Acids in Nutrition, A145
SALSBURY, R. L., effect of trace elements on the metabolism of calcium and phosphorus, A48; mineral supplementation and blood composition, A147
SANDERS, GEORGE P., phosphatase test for pasteurization, A115
SCHAEFER, W. F., cost of getting cow with calf, A29
SCHARP, L. A., Babcock test, A75
SCHMALFUSS, H., deterioration of fat, A64
SCHMITT, J. A., milking apparatus, A11
SCHOCK, A. A., rennet method for cottage cheese, A45; manufacture of cultured buttermilk, A79; manufacturing cottage cheese, A78; off-flavors in market milk, A86
SCHOENING, HARRY W., Manual of Veterinary Bacteriology, A131

SCHROEDER, C. R., penicillin blood and milk concentrations, A157
SCHULZ, M. E., riboflavin-reductase, A62
SCHWARZKOPF, V., cleaning cans, A105
SCHWEIGERT, B. S., riboflavin ingestion and amount in milk and urine, A9
SELLERS, A. F., expulsion of fetal membranes, A146
SHANNON, R. E., advertising, A107
SHAW, J. C., ketosis in dairy cattle, A47
SHAW, R. K., production of churning cream, A162
SHELANSKI, H. A., physiological action of sodium carboxymethylcellulose, A158
SHELOR, ETHYL, preparing peaches for freezing, A91
SHERE, L., hypochlorites and quaternary ammonium compounds, A105
SHERMAN, M., administration of vitamin A in oily and in aqueous media, A50
SHEW, D. I., Babcock test, A75
SIGONNEY, L., "blue" defect of soft, mold-cured cheese, A94
SIMMONS, H. F., production levelling, A140
SIMONET, R. A., chocolate ice cream, A120
SKINNER, C. E., Henrici's Molds, Yeasts and Actinomycetes, A1
SMITH, J. K., milk rations and dental caries, A100
SNOW, SELIG, administration of vitamin A in oily and in aqueous media, A50
SOBLE, A. E., administration of vitamin A in oily and in aqueous media, A50
SONBORG, O. W., waste saving and disposal, A58
SOUTHERWICK, H. I., continuous flow pasteurizer, A102
SPECK, M. L., bacteria in pasteurized milk, A74
SPEERS, ANNA M., family consumption of dairy products, A130
SPEIRS, R. J., plastic cream, A18
SPENCER, G. R., bovine brucellosis, A96
SPENCER, L., demand side of the milk market, A22; sales, expenses and profits of metropolitan milk companies, A57; open and closed cream markets, A143
SPIELMAN, A. A., supplementary vitamins for calves, A65
SPROULE, W. H., retention of minerals and vitamins in cheesemaking, A113
STAMBERG, O. E., recombined and reconstituted milk, A103
STANLEY, G. E., sanitation control for milk, A126
STEFFEN, G. I., enterococcal food poisoning, A116
STEFFEN, H. J., waste saving and disposal, A58
STEWART, G. F., coliforms in egg products, A154
STOIAN, C., sheeps' butter in Roumania, A30
STOLTZ, R. B., training young men for the dairy industry, A58
STRANSKY, J., milk bottle cap, A103
STRAUB, EVELYN E., growth-promoting activity of vaccenic acid, A79
STRELITZ, FRIEDA, antiobiotics active against bacterial viruses, A162
STREZYNSKI, G. J., centrifugal separation of serum from cheese constituents, A31, A62
SWAIN, A. P., combination of formaldehyde with casein, A115
SWINTOSKY, E. P., can drying rack, A166
SYKES, J. F., inanition and mammary-gland development, A128
SYMMES, C. R., frozen food container, A165

TANNER, F. W., Bacteriology. A Textbook of Microorganisms, A132
TANNER, F. W., JR., Bacteriology. A Textbook of Microorganisms, A132
THACKER, W. C., chocolate milk drinks, A77, A140
THIBODEAU, R., extraneous matter test for Cheddar cheese, A112; extraneous matter in Cheddar cheese, A113
THOM, E., billing retail customers, A88; franchise dealers for ice cream, A100; factory-produced carry-out sundaes, A136
THOMAS, S. C., rinses and swabs of farm dairy utensils, A39
THOMPSON, J. B., browning reaction involving copper-proteins, A146
THOMSEN, L. C., plant operation and efficiency, A138
THORNTON, H. R., production of churning cream, A162
TOBEY, JAMES A., Legal Aspects of Milk Sanitation, A61
TORTORELLA, A., B.C.G. bacillus in Uruguay, A3
TRACY, P. H., overrun control in ice cream, A33; mix stabilizers and whipping agents for ice cream, A118; homogenized milk problems, A125
TREMBATH, R., Babcock test, A75
TRETSVEN, W. I., cottage cheese manufacture, A78; milk powders for cottage cheese, A95

TROUT, G. M., single standard of milk quality, A22; phosphatase test for homogenized milk, A55; oiling-off of frozen cream, A90; quality in milk, A124; simple standard of milk quality, A125
TSUCHIYA, H. M., Menrici's Molds, Yeasts and Actinomycetes, A1
TUREMAN, G. R., JR., brucellosis, A156
TURK, K. L., supplementary vitamins for calves, A65
TURNER, C. W., feeding thioprotein and thiouracil, A99; sex hormones and pituitary lactogen, A104; thiouracil and estrogen administration to rats, A104

VERNON, T. R., temperature and humidity control in cheese curing, A7
VERRALL, S. A., rate of machine milking, A11
VIGUE, R. F., streptomycin for calf pneumonia, A32

WAECHTER, R. F., mastitis, A32
WALKER, E. L., quality in ice cream, A119
WALKER, F. M., binding of sulfonamides, A76
WALKER, H. B., determination of quaternary ammonium compounds, A18
WARD, G. M., effect of calcium, manganese and other trace elements on the metabolism of lipids, A48; effect of trace elements on the metabolism of calcium and phosphorus, A48; manganese metabolism in cattle, A116; mineral supplementation and blood composition, A147
WARKANY, J., epithelial keratinization in vitamin A deficiency, A98
WATROUS, G. H., JR., modified microscopic method for bacteria in milk, A2; technics for microscopic analysis of milk, A73
WATSON, C. J., iodized rock salt, A98; nutritive ratio and digestibility, A98
WATSON, D. W., resazurin test, A153
WEBB, H. A., Babcock test, A75
WEBER, C. A., future of H.T.S.T. pasteurization, A20
WECKEL, K. G., new products and milk sales, A139
WEGENER, J. B., brine freezing strawberries, A91
WEIL, C. S., statistical evaluation of growth curves, A106
WELSH, MARK, penicillin blood and milk concentrations, A157
WHITE, A. H., plate count of milk powders, A27
WHITE, W. HAROLD, fluorescence method for assessing keeping quality of butter, A29
WHITTLESTON, W. G., rate of machine milking, A11; milk-ejection curve of normal dairy cows, A12; efficient mechanical milking, A148
WICKSTRUM, C. M., cream separator, A19
WIDDOWSON, E. M., chemical composition of foods, A1
WIEGAND, E. H., frozen berry purees for ice cream, A121
WILKIN, MARIAN, coliforms in egg products, A154
WILKINSON, R., ferric thiocyanate method for peroxide, A8
WILSON, H. L., factors influencing the quality of cheese, A30; cheese from pasteurized milk, A133; composition control of Cheddar cheese, A154
WILSON, J. G., epithelial keratinization in vitamin A deficiency, A98
WILSTER, G. H., texture of Cheddar cheese, A6; dual use of the vacreator, A45
WINTER, A. R., coliforms in egg products, A154
WISE, G. H., determination of vitamin A and carotenoids, A116
WISNIEWSKI, T. F., waste disposal for country plants, A25
WITTIG, G., phosphatase destruction by heat, A163
WOLF, C., irradiation of milk in the U. S., A38
WOLFRUM, ING. OTTO, milk can production in Austria, A70
WOOD, F. W., production of churning cream, A162
WOOD, J. L., combination of formaldehyde with casein, A115
WOOD, R. M., standardization of brucella antigen, A153
WOODROOF, J. G., preparing peaches for freezing, A91
WREN, T. R., inanition and mammary-gland development, A128
WRISLEY, K. S., siphon for removing cream from bottles, A71

YOUNG, E. M., determination of quaternary ammonium compounds, A18

ZIEGLER, MILDRED, meat and milk as sources of calcium, phosphorus and protein, A99

SUBJECT INDEX OF ABSTRACTS

ABORTION, staphylococcal, in cattle, A32
Acetoin, importance in butter culture aroma, A61
Acetonemia, in dairy cattle, A47
Acid, lactic, as indicator of ice cream quality, A52
Actinomycetes, A1
Advertising,
  basis for, A107
  billboard, of ice cream, A68
Albumin, of bovine serum,
  binding of sulfonamides by, A76
  metallo-protein combinations of, A76
Amino acids, D forms in racemized casein, etc., antibacterial activity of, A154
Ammonia absorption system, for refrigerator cars, A41
Anasarca, in beef cattle, and vitamin A deficiency, A50
Anti-bacterial activity, of D-amino acids, A154
Antibiotics, active against bacterial viruses, A159
Ascorbic acid, polarographic estimation of, in milk, A8
Ayrshires, hereditary epithelial defects of, A146

BABCOCK test, technic of, A75
Bacteria,
  in pasteurized milk, A74
  lactic acid, inhibition by analogs of pantothenic acid, A132
B.C.G. bacillus, cultivation of, A3
Beef cattle, vitamin A deficiency in, A50
Billing, of retail milk customers, A88
Blood, bovine, penicillin concentration in, A157
Blood groups, of cattle, A24
Blood serum, bovine, determination of vitamin A and carotenoids in, A116
Boilers, conversion to oil or gas, A129
Book reviews,
  Advances in enzymology, Vol. VII, A43; *ibid.*, Vol. VIII, A131
  Annual review of biochemistry, Vol. XVI, A17; Vol. XVII, A159
  Annual review of microbiology, Vol. I, A43
  Artificial insemination of dairy cattle, A151
  Bacteriology, a textbook of microorganisms, A132
  Fatty acids, their chemistry and physical properties, A17
  Food products, A2
  Food regulation and compliance, A27
  Henrici's molds, yeasts, and actinomycetes, A1
  Industry builder. The biography of Chester Earl Gray, A73
  Legal aspects of milk sanitation, A61
  Manual of veterinary bacteriology, 5th Edn., A131
  Practical emulsions, A1
  Proteins and amino acids in nutrition, A145
  Standard methods for examination of dairy products, 9th Edn., A151
  The chemical composition of foods, A1
Bottle,
  milk,
    cleaning of square vs. round, A57
    oblong 2-quart glass, A138
    utility top for, A103
  paper, design of, for milk, A56
Bottle cap, for milk, A71
Bottle closure, for milk, A149
Bottle washing, problems in, A126
Bottles, cleaning of, A24
Bound water, of cheese, A94
Bowman program, for "dry stop" volume, A53
Breeding, cost, A29
Breeding unsoundness, in cows, diagnosis of, A65
Brine tank, for frozen confections, A149
Browning reaction, involvement of copper-proteins in, A146
Brucella, agglutination tests for, and cholera vaccination, A19
Brucella abortus, inhibitory action of pyocyanin against, A3
Brucella ring test, preparation and standardization of antigen for, A153
Brucella suis, inhibitory action of pyocyanin against, A3
Brucellosis,
  an occupational disease, A19
  bovine, in dairy industry, A96

Brucellosis—*continued*
diagnosis and therapy, A156
discussion of, A47
in industry, in Iowa, A156
Bulls, infertility in, causes and diagnosis, A29
Butter,
composition control of, A61
control of moisture content during manufacture, A4
defects of, A74
fatty acids, nutritive value of, A10
flavor, from land-cress, A5
free tryptophane in, A63
keeping quality, fluorescence method of assessing, A29
isolation of aroma-producing ferments for, A28
neutralization of cream for, A4
oiliness and fishiness of, A161
oiling-off of, A162
oxidation of fat, A9
pH regulation of, A161
physical structure of, A162
production by Fritz machine, A110
sample preparation for analysis, A111
sheeps' (cashcaval), A30
use of vacreator, on cream for, A45
washing, effect on curd content and quality, A5
Butter cultures,
acetoin and diacetyl in, A61
isolation of aroma bacteria from, A28
Buttermilk,
condensed, sampling and analysis of, A65
cultured, manufacture of, A46; A79
utilization in New Zealand, A9

CABINETS, for ice cream, A83
Calcium,
effect of trace elements on mttabolism of, A48
effect on lipid metabolism, A48
inorganic, in blood serum of the cow, A13
Calves,
supplementary vitamins for, A65
thiamine deficiency of, A49
Cans,
washing compounds for,
corrosion of tin plate by, A14
germicidal efficiency of, A13
washing of,
chemistry of, A88
in creameries and milk plants, A126
Carotenoids, determination in bovine blood serum, A16
Casein,
formaldehyde combination with, A115
microbial differentiation of, from lactalbumin, A31
Cashcaval butter, A30
Cattle,
blood groups of, A24
vitamin A for, A66
Centrifuge, separation of serum from cheese constituents with, A31
Check valves, of pipelines, A107
Cheese,
bound water of, A94
brie, "blue" defect of, A94
camembert, "blue" defect of, A94
Cheddar,
Canadian research problems in, A114
composition control of, A154
controlling moisture of, A154
correcting defects in, A112
extraneous matter in, A62; A112
factors influencing texture, A6
fat and moisture in, A114
from pasteurized milk, A133
openness in, A112
premium payments for high fat, A6
preservation of samples for tests for extraneous matter, A113
sampling of, A114
starters for making, A112
with pasteurized milk, A111
Chloropicrin, use for milk preservation, A159
Chocolate milk, suspending agent for, A166
Choline, in Canadian live stock feeds, A165
Clostridium acetobutylicum, vitamin concentrates from whey using, A160
Container, for ice cream, A165
Coulommiers, "blue" defect of, A94
cottage,
freezing preservation of, A155
manufacture by rennet method, A45
manufacture from nonfat dry milk solids, A46
manufacture of, A78
manufacturing procedures, A78
nonfat dry milk solids for manufacture of, A95
sweet curd, A17

Cheese—*continued*
cream,
removal of serum from, A62
separation of serum through centrifugation, A31
ferments for, A6
Gouda, manufacture of, A75
Gruyere, rheological experiments on, A30
malted process, brown discoloration in, A155
mites, control measures against, A7
nutritional value of, A117
quality, factors influencing, A30
relation to disease, A7
retention of minerals and water-soluble vitamins during making, A113
Cheesemaking,
direct steam pasteurization for, A6
increased yield, A112
temperature and humidity control in curing rooms, A7
Chemical composition, of foods, A1
Chemical preservation of milk, A12
Cholera, vaccination for, and brucella agglutination tests, A19
Chlorine, residual, in milk, A64
Chloropicrin, in milk preservation, A110
Chocolate, forms to use in ice cream, A120
Cleaning,
of bottles, A24
of dairy equipment, A127
of dairy utensils, examination of rinses and swabs, A39
Cleaning and disinfecting, of milk and ice cream equipment, A141
Clostridium acetobutylicum, for riboflavin synthesis from whey, etc., A28
Coliform bacteria, in liquid egg products, pasteurization destruction of, A153
Coliform test, for pasteurized milk, A12
Concentrates, for cows on winter pasture, A147
Containers, single service, for milk, A70
Continuous churning, Fritz machine for, A110
Cooling unit, for liquids, A23
Copper, estimation in cream, A8
Copper-proteins, involvement in browning reaction, A146
Corrosion, of tin plate, by can-washing compounds, A14
Costs,
in ice cream retail outlets, A68
in milk production and handling, A23
of 6 metropolitan milk companies, A57
Cream,
churning, production methods and keeping quality, A162
copper determination in, A8
flavor, from land-cress, A5
free tryptophane in, A63
frozen, "oiling off" of, A90
open and closed markets for, A143
plastic, A18
quality of,
influence of separator cleanliness on, A44
influence of storage temperature of cream on, A44
sediment testing of, A44
viscosity of, A87
Cream whipper, A166
whipping (aeration) of, A77
Cream analysis, A31
Cream separator, A19
for bottled milk, A45
Creamery, fat losses in, A111

DAIRY bacteriology, 3rd Edn., A109
Dairy cattle,
comparative rates of production of different breeds, A11
economical ration for, A49
vitamin A intake, A10
Dairy industry, training young men for, A58
Dairy plant, country, waste disposal for, A25
Dairy products,
family consumption of, A130
nutritive value of butter fatty acids, A10
Dairy ration, procedure for making, A49
Dairy technologists, practical training for, A41
Dairy wastes, A58
DDT,
persistence on cattle, A11
toxicity to houseflies of paints containing, A14
Delivery problems, of single service containers, A70
Dental caries, of rat, effect of milk rations on, A100
Detergents, chemical and physical aspects of, A39
Diacetyl, importance in butter culture aroma, A61
Dichlorethyl ether, for control of cheese mites, A113
Differentials, for milk, in stores, A53

Digestion studies, in rumen, A47; A48
Direct microscopic count,
for milk, staining procedures for, A109
new staining formulas for, A151
Disease, relation of cheese to, A7
Disinfectants, hypochlorites and quaternary ammonium compounds as, A105
Drive-in operations, for ice cream sales, A36
Dry milk, proteins, estimating baking quality of, A9

EDEMA, in beef cattle, effect of vitamin A on, A50
Egg products, pasteurization of, for control of coliform bacteria, A154
Employer-employee relationships, in dairy plant management, A90; A142
Emulsifiers, for ice cream, A117, A118
Emulsions and emulsifying agents, A1
Epithelial defects, hereditary, in ayrshires, A145
Escherichia coli, in ice cream, A152
Estrogen, lactogenic hormone of rats influenced by, A104
Ethyl gallate, as antioxidant in dried milk powder, A116
Extraneous matter, in Cheddar cheese, A62, A112

FAT,
basis for premium value for Cheddar cheese, A6
deterioration of, A64
estimating peroxide in, A8
oxidation of, in butter, A9
Fat losses, in creameries, A111
Fat tests, of milk, variation in, A54
Fatty acids
nutritive value of, in butter, A10
unsaturated higher, structural relationship among, A133
Federal Food and Drug act, A40
Fermentation, for preparing vitamin concentrate, A161
Fetal membranes, postpartal expulsion of, A146
Fillings, pastry, growth of staphylococci in, A4
Fish, frozen, in the freezer warehouse, A92
Flavor, of ice cream, evaluation of, A121
Flavors, of market milk, A86
Fluorescence, assessing keeping quality of butter by, A29
Follicle cell dispersal, in rat ova, and time of fertilization, A93
Food and Drug Act, federal, A40
Food poisoning, enterococcal, in man, A116
Food products,
determination of iron in, A8
formulary, A2
Food regulation and compliance, A27
Foods, chemical composition of, A1
Forage crops, for increased production, A49
Formaldehyde, combination of, with casein, A115
Franchise dealers, for selling ice cream, A100
Freezing point, of milk, A38
Fritz butter machine, studies on, A110
Frozen confections, brine tank for, A149
Frozen food, transportation of, A92
Fuel, conversion to oil from coal, A144

GERMICIDES, efficiency of, for can washing, A13
Globulins, gamma, of bovine serum, A64
Gonadotrophic hormones, effect on lactation, A104
Grocery stores, ice cream marketing in, A36
Growth curves, statistical evaluation of, A106; A106
Gruyere cheese, rheological experiments on, A30

HARDENING, of ice cream, A120
Heat exchanger, for milk, A149
Homogenization,
apparatus for, A129
of milk, problems in, A125
Hormone therapy, causes for failure of, A39
Hormones, sex, effect on pigeons, A104
Houseflies, toxicity of DDT paint for, A14
Housekeeping, in dairy plants, A105
Humidity control, in cheese-curing rooms, A7
Hyaluronidase, testis, and fertilizing capacity of rabbit spermatozoa, A94
Hypochlorites, as disinfectants, A127
Hypochlorite solutions, for dairy equipment, A127

ICE cream,
algin stabilizer for, A157
automatic packaging, A35
bacteriological examination of, A152

ICE CREAM—*continued*
billboard advertising for, A68
building "dry stop" volume for, A53
bulk, dealers' profits in dipping of, A157
bulk gallon, A35
cabinet and truck space utilization for, A83
cabinets for, A83
carry-out sundaes, factory produced, A136
chocolate, A120
concentrated and dry mixes, A135
consumer buying habits on, A101
consumer panel for taste-testing of, A122
container for, A165
control of raw materials and partly finished products for, A50
costs, prices, profits, A37
cutting and discharging device for, A157
delivery of, A84
deluxe package for, A148
drive-in operations, A36
drive-in retail stores, A36
emulsifying and stabilizing agents for, A117
flavor, evaluation of, A51; A121
folded package for, A148
foreign fats in, A148
gallonage of, in 1947, A86
hardening of, A120
improvement with emulsifiers, A118
laboratory control of, A81
liquid sugar in, A52
manufacturing and sales trends, A123
marketing in grocery stores in smaller towns, A36
mix, H.T.S.T. pasteurization of, A119
muscadine and peanut butter flavors for, A135
nutritive value of, A35; A99
oat flour stabilizer, A38
outlook for cream and milk solids for, A67
overrun control in, A33
packaged, improvement of, A34
packaging of, A85
price trends of, A86; A137
processing, control of, A81
quality, true lactic acid content as indicator of, A52
quality control, A119
retail pricing guide for, A137
retail stores for A101; A149
sale by weight, A123
selling, by franchise dealers, A100
selling technics, A119
shrinkage of, A33; A81; A82; A119
soda fountain pricing of, A102
stabilizers and whipping agents for, A118
stabilizers for, A66
sugar of, relation to tooth decay, A134
vanilla in, A34
Ice cream dipper, A165
Ice cream mix,
dry powder for, A38
fat content of, A80
HTST pasteurization of, A80
pasteurization of, by Vacreator, A45
prevention of sandiness in, A67
Inanition, effect on mammary-gland development and lactation, A128
Infertility, causes and diagnosis of, in bulls, A29
Insect control, in food plants, A40
Inspection, of farm milk supply, A126
Iodine, stability in iodized rock salt, A98
Ionic exchangers, in dairy industry, A76
Iron, determination of, in food products, A8
Irradiation, of milk, in U. S., A38

KEFIR,
directions for making, A9
manufacture of, A78
Keratinization, epithelial, vitamin A deficiency and, A98
Ketosis, in dairy cattle, A47
Koehler-Bacot method, modification of, for cream analysis, A31

LABORATORY, control for ice cream, A81
Lactalbumin, differentiation of, from casein, A31
Lactation, effect of inanation on, A128
Lacteal liquids, fractionation of, A100
Lactic acid, determination in foods, A63
Lactoglobulin, beta, specific refractive increment of, A156
Lactoglobulins, studies on, A76
Lactose, manufacture of, A146
Land-cress taint, in butter and cream, A5
Leuconostoc mesenteroides, riboflavin determination with, A44
Lipids, effect of calcium and trace elements on metabolism of, A48
Locker plants, state laws relative to, A92

MAMMARY gland development, effect of inanation on, A128

MAMMARY—*continued*
Management, employer-employee relationships, A90; A142
Manganese,
effect on calcium and phosphorus metabolism, A48
effect on lipid metabolism, A48
Manganese metabolism, in lactating bovine. A116
Mastitis,
chronic, A32
in N. Y. state, research and control, A46
penicillin action on bacteria of, A74
Mesophilic bacteria, A74
Methylene blue test, for ice cream, A152
Microbial process, for differentiation of casein and lactalbumin, A31
Microbiological assay, for riboflavin, A44
Microlysine-tear gas (chloropicrin), in milk preservation, A110
Microorganisms, of milk products, characterization and control of, A110
Microscopic count, of milk, A73
Microscopic method, modification of, for milk control, A2
Milk,
addition of chemical substances for preservation, A12
bacterial groups in, A74
base and surplus plan for leveling production, A140
bottle cap for, A71; A149
calcium, phosphorus and protein source, A99
chocolate,
factors in high quality, A140
making, A77
manufacture of, A139
coliform test for, A12
keeping quality of, A116
estimation of ascorbic acid in, A8
freezing point of, A38
frozen,
as preservation method, A137
whole, A20
greater production of, A103
heat exchanger for, A149
homogenized,
phosphatase test for, A55
problems in, A125
processing of, A69
inspection of farm supply of, A126
irradiation of, in U. S., A38
kefir, directions for making, A9
kefir fermented, A78
laboratory pasteurization of, A110
market demand for, A22
microscopic analysis of, A73
money losses in marketing of, A70
off flavors of, A86
pasteurization, future of H.T.S.T., A20
pasteurized,
Cheddar cheese manufacture from, A133
keeping quality of, A54
microscopic control of, A2
penicillin concentration in, A157
plate counts of, variability of, A73
portable pasteurizer for, A71
powdered,
cottage manufacture from, A46
variations in technique on plate count of, A27
preservation of, with chloropicrin, A159
production and consumption in Canada, A126
production and handling cost publicity, A23
quality, establishing a single standard of, A22
quality improvement, A69
quality in, A124
quality and production of, A125
raw, microscopic control of, A2
recombined and reconstituted, A103
residual chlorine in, from hypochlorite, A64
riboflavin contents of, A9
sales developments for, A139
sales, expenses, profits for, A57
sanitary control of, A126
sediment in, from teat cups, A88
serum methods for added water in, A63
single quality standard for, A125
single service containers for, A70
store differentials for, A53
synthetic, for raising pigs, A134
3-day delivery of, A88
trace sugars in, A164
vitamin D, control of, A21
Milk can,
cleansing of, A105
drying rack for, A166
production in Austria, A70
strainer accommodating attachment for, A166
Milk container, paper, A71
Milk-ejection curves, of normal dairy cows, A12

MAMMARY—*continued*
Milkfat,
dry, as storage fat, A96; A134
glyceride composition of, A146
increase by feeding brewer's yeast, A97
solvent treatment, effect of on growth of rats, A50
Milk plants, operation and efficiency of, A138
Milk production, leveling of, A55
Milk products, in bread making, A77
Milk strainer, supporting rack for, A158
Milk sugar, manufacture of, A146
Milk tests, fat variation in, A54
Milk tubes, sterilizing arrangement for, A149
Milker pails, cover and filter for, A149
Milking apparatus, A11
Milking machines, A166
apparatus for washing of, A150
effect of adjustments on rate, A11
efficiency of, A148
sanitation of, A89
Minerals, trace, for dairy cattle, A66
Mineral supplementation, effect on blood of cows and calves at parturition, A147
Mites, cheese,
control of, A7
control with dichlorethyl ether, A113
Mix, concentrated and dry, for ice cream, A135
Moisture, control of, in butter, A4
Molds, A1

NEUTRALIZATION,
detection of, in nonfat dry milk solids, A63
of cream for buttermaking, A4
New Zealand, utilization of buttermilk in, A9
New Zealand milks, B vitamins in, A8
Niacin, in New Zealand milks, A8
Nitrous oxide, cream aeration by, A77
Nonfat dry milk solids,
cottage cheese manufacture with, A95
neutralization detection in, A63
Nutritional value, of cheese, A117
Nutritive ratio, effect on digestibility by cattle, A98

OAT flour, stabilizer, in ice cream and sherberts, A38
Operation and efficiency, of milk plants, A138
Overrun, control of, in ice cream, A33
Oxidation, of fat, in butter, A9

PACKAGE,
deluxe for ice cream, A148
folded for ice cream, etc., A148
Packaging, of ice cream, A85
Panthothenic acid, analogs of, inhibition of lactic acid bacteria by, A132
Pasture, all year, concentrate supplementation of, A147
Pasteurization,
H.T.S.T., time factor in, A124
laboratory, for milk control, A110
laboratory H.T.S.T., A87
of ice cream mix, A80
of milk,
for making Cheddar cheese, A111
future of H.T.S.T., A20
portable apparatus for, A71
phosphatase test for, A115
Pasteurizer,
continuous flow, electric, A102
H.T.S.T., timing of, A87
Pasteurizing apparatus, A15, A166
Peaches, preparation for freezing, A91
Penicillin,
action on mastitis organisms, A74
blood and milk concentrations of, in cow, A157
Peroxide, estimation in fat, A8
Personnel training, foremen and supervisors, A41
Phosphatase, destruction by heat, A163
Phosphatase test,
for determination of pasteurization of dairy products, A115
for homogenized milk, A55
Phosphorus,
effect of trace elements on metabolism of, A48
in blood serum of the cow, A13
milk and meat as source of, A99
Pituitary lactogen, of pigeon, effect of sex hormones on, A104
Plate count, of milk powders, A27
Plate counts, of milk, A73
Pneumonia,
calf, treatment with streptomycin, A32
in cattle, treatment with sulfamerazine, sulfamethazine and penicillin, A32
Polarographic estimation, of ascorbic acid, in milk, A8
Production, comparative rates for different breeds of dairy cattle, A11

Protein,
crystalline pepsin-resistant, A65
milk and meat as source of, A99
Proteins,
of milk, separation from milk, whey, etc., A100
purified, specific refractive increment of, A156
whey, as indication of baking quality, A9
Pseudomonas pyocyanea, action against the brucellas, A3
Psychrophilic bacteria, A74
Purees, frozen berry, in dairy industry, A121

QUALITY control, in dairy plants, A90
Quaternary ammonium compounds,
determination of, A18
disinfectant properties of, A105
for sanitizing equipment, A127
germicidal effect on dairy organisms, A40
test for, A127

RADIOAUTOGRAPHS, of tissue mounts, A107
Refrigeration,
for dairy plants, A141
for milk bottling plants, A56
new developments in, A130
Refrigeration coils, defrosting of, A34
Refrigerator car, ammonia absorption type, A41
Rennet method, for manufacture of cottage cheese, A45
Resazurin test, review of literature on, A153
Research, value to dairy industry, A129
Retail stores, for ice cream, A82; A101; A136; A149
Riboflavin,
effect of ingestion on amount in milk and urine, A9
fermentation process for,
adjustment of pH in, A29
iron addition in, A28
fermentative production from whey, A160
in New Zealand milks, A8
iron and magnesium in fermentative production of, A161
iron and zinc in fermentative production of, A161
microbiological assay for determination of, A44
preparation from whey and skim milk containing added kylose, A28
Riboflavin reductase, A62
Rodent control, in food plants, A40
Rumen,
methods for chemical changes in, A47
studies in the chemistry of digestion, A48

SANDINESS, prevention in ice cream, A67
Sanitary practices and controls, in the dairy industry, A140
Sanitation,
dairy plant, A89
milking machine, A89
testing kit for, A128
Salt, rock, iodine stability in, A98
Sediment testing, of cream, A44
Separator,
cleanliness of, influence on cream quality, A44
cream, A19
for bottled milk, A45
fiberboard container used as, A71
siphon type, for milk, A71
Serum, bovine, gamma globulins in, A64
Serum methods, for added water in milk, A63
Sherbets, status of, A83
Shrinkage, in ice cream, A33; A81; A82
Skim milk, as substratum for riboflavin production, A28
Sodium carboxymethylcellulose, physiological action of, A158
Sodium-chlorine relationship, for detecting sodium neutralized nonfat dry milk solids, A63
Spermatozoa, rabbit, fertilizing capacity of, A94
Stabilizers,
algin, for ice cream, A157
for ice cream, A66; A117; A118
Staining formulas, for direct microscopic examination of milk, A151
Staining procedures, for direct microscopic examination of milk, A109
Stalls, cattle, electrical system for, A12
Staphylococci, abortion in dairy cattle caused by, A32
Staphylococcus aureus, growth in pastry fillings, A4
Steam pasteurization, direct, for cheesemaking, A6
Stick novelties, in medium-sized plant, A122
Stock watering tank, A11

Storage temperature, cream quality influenced by, A44
Strawberries, frozen tinned, A91
Streptococci, Lancefield group B from human sources, A93
Streptococcus agalactiae, biological characteristics and mouse virulence of, A93
Streptococcus faecalis, as cause of food poisoning, A116
Streptococcus thermophilus, in yoghurt, and whey separation, A96
Streptomycin, calf pneumonia treatment with, A32
Succinic acid, determination in foods, A63
Sugar, liquid, in ice cream, A52
Sulfamerazine, pneumonia treatment in cattle with, A32
Sulfonamides, binding by bovine serum albumin, A76
Supply sales, to farmer, by dairy plant, A40
Suspending agent, for chocolate milk, A166

TANK, stock watering, A11
Taste-testing, of ice cream, consumer panel for, A122
Technologists, dairy, practical training for, A41
Temperature control, in cheese-curing rooms, A7
Testing kit, for sanitation control, A128
Texture, of Cheddar cheese, factors influencing, A6
Thermoduric bacteria, A74
Thiamin,
  in New Zealand milks, A8
  deficiency of, in calf, A49
Thiouracil,
  effect on growth and fattening rate, A99
  effect on rats, A104
Thyroprotein,
  effect on growth and fattening rate, A99
  synthetic, feeding to dairy cows, A164
Tin plate, corrosion by can washing compounds, A14
Tooth decay, relation of sugar in ice cream to, A134
Trace elements, effect on lipid metabolism, A48
Trace sugars, in milk, A164
Training, for dairy industry, A58
Triiodides, determination of quaternary ammonium compounds as, A18
Trucks, selection and applications, A25
Tryptophane, free, determination of, in milk, cream and butter, A63

ULTRAVIOLET radiation, uses in dairy industry, A110
Unidentified nutrient, in dairy products, A165
Urea, feeding to dairy cows, A97
Urine, riboflavin content of, A9

VACCENIC acid,
  configuration of, A75
  growth-promoting activity of, A79
Vacreator, dual use of, A45
Vanilla,
  evaluation of, A79
  for ice cream, A34
Vanillic acid esters, as spore-controlling agents, A153
Viruses, bacterial, antibiotics against, A160
Vitamin A,
  deficiency of, and epithelial keratinization, A98
  determination in bovine blood serum, A116
  effect of intake on hepatic stores and blood levels, A10
  for dairy cattle, A66
  in Cuban cow's milk, A155
  liver storage of, in rats, A50
  oily vs. liquid media for administration of, A50
  recent developments concerning, A133
  relation to edema of beef cattle, A50
Vitamin D, in milk, control of, A21
Vitamins,
  supplementary, for calves, A65
  enhancing yield in whey fermentaton, A161
  iron and magnesium in fermentative production of, A161

WASTE disposal,
  for country plants, A25
  in dairy plants, A58
Water, chemical treatment of, in the creamery, A128
Water treatment, in dairy industry, A91
Whey, as substratum for riboflavin production, A28
Whey proteins, estimation in dry milk, as indication of baking quality, A9

YEASTS, A1
Yoghurt, whey separation in, A96

JOURNAL
OF
DAIRY SCIENCE

VOLUME XXXI
JANUARY, 1948, TO DECEMBER, 1948

1948
AMERICAN DAIRY SCIENCE ASSOCIATION
THE OHIO STATE UNIVERSITY, COLUMBUS, OHIO

THE AMERICAN DAIRY SCIENCE ASSOCIATION

Editor

F. E. NELSON, Ames, Iowa

Associate Editors

C. A. CARY, Beltsville, Md.
P. R. ELLIKER, Corvallis, Oreg.
I. A. GOULD, College Park, Md.
O. F. HUNZIKER, La Grange, Ill.
E. P. REINEKE, East Lansing, Mich.
H. A. RUEHE, Urbana, Ill.
I. W. RUPEL, College Station, Tex.
G. H. WISE, Ames, Iowa

Committee on Journal Management

T. S. SUTTON, Columbus, Ohio, *Chairman*
P. R. ELLIKER, Corvallis, Oreg.
G. H. WISE, Ames, Iowa
P. R. ELLSWORTH, Columbus, Ohio, *ex officio*
F. E. NELSON, Ames, Iowa, *ex officio*

Officers of the Association

W. E. PETERSEN, *President*
St. Paul, Minn.
G. M. TROUT, *Vice-President*
East Lansing, Mich.
P. R. ELLSWORTH, *Acting Sec.-Treas.*
Columbus, Ohio
F. E. NELSON, *Journal Editor*
Ames, Iowa

Directors

C. Y. CANNON, Ames, Iowa
H. B. HENDERSON, Athens, Ga.
S. J. BROWNELL, Ithaca, N. Y.
P. F. SHARP, San Francisco, Calif.
P. H. TRACY, Urbana, Ill.
P. R. ELLIKER, Corvallis, Oreg.
J. H. HILTON, Raleigh, N. C.

Section Officers

Production Section

L. A. MOORE, Beltsville, Md., *Chairman*
G. M. CAIRNS, Maryland, *Vice-Chairman*
L. O. GILMORE, Ohio, *Secretary*

Manufacturing Section

E. M. BARKER, Rochester, Minn., *Chairman*
D. V. JOSEPHSON, Penn., *Vice-chairman*
J. H. HETRICK, Ill., *Secretary*

Extension Section

G. HEEBINK, West Virginia, *Chairman*
C. W. REAVES, Florida, *Vice-Chairman*
RAY ALBRECTSEN, New York, *Secretary*

BUSINESS PRESS, INC.
LANCASTER, PENNSYLVANIA

CONTENTS

JANUARY, NO. 1

Studies of the growth and blood composition of dairy calves fed remade skim milk after three days of age. L. R. ARRINGTON AND P. M. REAVES 1

The effect of penicillin upon the livability, glycolysis, and bacterial content of bovine semen. J. O. ALMQUIST, W. T. S. THORP, AND C. B. KNODT 11

The effect of conditions of storage and the viscosity of sweetened condensed milk. B. H. WEBB AND C. F. HUFNAGEL 21

Determination of cheese lipase. MERLIN H. PETERSON, MARVIN J. JOHNSON, AND WALTER V. PRICE 31

Lipase activity during making and ripening of Cheddar cheese. MERLIN H. PETERSON, MARVIN J. JOHNSON, AND WALTER V. PRICE 39

Determination of cheese proteinase. MERLIN H. PETERSON, MARVIN J. JOHNSON, AND WALTER V. PRICE 47

Proteinase content of Cheddar cheese during making and ripening. MERLIN H. PETERSON, MARVIN J. JOHNSON AND WALTER V. PRICE 55

The heritability of official type ratings and the correlation between type ratings and butterfat production of Ayrshire cows. W. J. TYLER AND GEORGE HYATT, JR. 63

Variations in type ratings of individual Ayrshire cows. GEORGE HYATT, JR., AND W. J. TYLER 71

The utilization of lactose by the dairy calf fed normal or modified milk diets. JORGE ROJAS, B. S. SCHWEIGERT, AND I. W. RUPEL 81

Association announcement 89

Abstracts of literature A1

FEBRUARY, NO. 2

The relationship of mammary development and body weight. J. R. SCHABINGER AND C. B. KNODT 95

Permanency of synthetic ascorbic acid added to milk. ARTHUR D. HOLMES AND CARLETON P. JONES 99

Sulfamethazine blood and milk concentrations in dairy cows. PETER H. LANGER, ROBERT L. BURKHART, CHARLES R. SCHROEDER, AND MARK WELSH 103

The utilization of β-carotene, vitamin A alcohol, and the natural ester of vitamin A by Holstein heifers. R. H. ROSS, C. B. KNODT, AND N. B. GUERRANT 111

Liveweight and milk-energy yield at various feeding intensities. S. D. MUSGRAVE AND W. L. GAINES 119

The chemical composition of the crystalline deposit in evaporated milk. EDGAR F. DEYSHER AND B. H. WEBB 123

The isolation and properties of the immune proteins of bovine milk and colostrum and their role in immunity: A review. EMIL L. SMITH 127

The utilization of whey: A review. BYRON H. WEBB AND EARLE O. WHITTIER 139

Abstracts of literature A17

MARCH, NO. 3

Effect of season, breed and species of ruminants on the vitamin A potency of butterfat. B. C. RAY SARKAR 165

Parturient paresis. II. The effect of partial versus complete milking upon the total blood serum calcium of dairy cows at parturition. VEARL R. SMITH, R. P. NIEDERMEIER, AND R. G. HANSEN 173

The value of hypochlorite and quaternary ammonium compounds, when used in udder washes, in reducing the plate count of milk. E. M. KESLER, G. H. WATROUS, JR., C. R. KNODT, AND P. S. WILLIAMS 179

The nutrition of the newborn dairy calf. I. Changes in the tryptophan content of the blood plasma following birth and the ingestion of colostrum. T. S. SUTTON AND G. C. ESH 183
A comparison of vacuum and steam distillation for determining the volatile acidity of evaporated milk. P. G. MILLER, P. L. ZIMMERMAN, AND E. B. OBERG 189
Curd tension test and curd number test applied to market homogenized milk in Philadelphia—definition of a soft curd milk. BERNHARD SPUR 199
Variations in yield of milk under the penkeeping system in Brazil. GERALDO G. CARNEIRO AND JAY L. LUSH 203
Abstracts of literature A27

APRIL, NO. 4

A comparative study of the biochemical activity of Streptococcus lactis, Streptococcus citrovorus, and Streptococcus paracitrovorus when grown in cow's milk and soybean milk. CHARLES W. GEHRKE AND HARRY H. WEISER 213
The role of surface-active constituents involved in the foaming of milk and certain milk products. III. Milk lipids, including phospholipids. G. A. RICHARDSON AND M. S. ELRAFEY 223
A study of multiple births in a Holstein-Friesian herd. K. O. PFAU, J. W. BARTLETT, AND C. E. SHUART 241
A study of the browning reaction in whole milk powder and ice cream mix powder. N. P. TARASSUK AND E. L. JACK 255
Iron and copper content of non-milk products commonly used in ice cream. HARRY PYENSON AND P. H. TRACY 269
The development of flavor in American Cheddar cheese made from pasteurized milk with Streptococcus faecalis starter. A. C. DAHLBERG AND F. V. KOSIKOWSKY 275
The growth and survival of Streptococcus faecalis in pasteurized milk American Cheddar cheese. F. V. KOSIKOWSKY AND A. C. DAHLBERG 285
The tyramine content of cheese. F. V. KOSIKOWSKY AND A. C. DAHLBERG 293
The relationship of the amount of tyramine and the numbers of Streptococcus faecalis to the intensity of flavor in American Cheddar cheese. A. C. DAHLBERG AND F. V. KOSIKOWSKY 305
Determination of vitamin A in milk. MELVIN HOCHBERG 315
Abstracts of literature A43

MAY, NO. 5

The effect of clipping the udders of cows on the quality of milk. E. W. HIRD, TULY REITER, K. G. WECKEL, AND N. N. ALLEN 325
Storage and treatment of milking machine inflations under farm conditions. J. M. JENSEN AND A. L. BOETTEE 333
Sweet potato meal versus ground corn in the ration of dairy cows. JENNINGS B. FRYE, JR., JOHN H. THOMASON, AND HERBERT B. HENDERSON 343
Correlation between the lactose content of milk and the cerebroside and choline content of brain. D. P. SADHU 349
Estimating the amount of feed derived from pasture by cows in the Connecticut Dairy Herd Improvement Association. G. E. FRICK AND H. D. EATON 355
Effect of water sprinkling with and without air movements on cooling dairy cows. D. M. SEATH AND G. D. MILLER 363
Measurement of fluorescent materials in milk and milk products. ROBERT JENNESS AND S. T. COULTER 369
The relationship of the change in pH effected by incubation to other semen characteristics. J. T. REID, G. M. WARD, AND R. L. SALSBURY 385
Association announcements 391
Abstracts of literature A61

JUNE, NO. 6

The spectrophotometric determination of the color of milk. VICTOR NELSON 409
The color of evaporated milk with respect to time and temperature of processing. VICTOR NELSON 415
Effect of raw soybeans and of soybean oil on plasma carotene and on vitamin A as measured by activated glycerol dichlorohydrin. R. L. SQUIBB, C. Y. CANNON, AND R. S. ALLEN 421
Simple versus complex concentrate mixtures for young breeding bulls. I. Growth, blood composition, and cost. J. T. REID, G. M. WARD, AND R. L. SALSBURY 429
Simple versus complex concentrate mixtures for young breeding bulls. II. Semen production. J. T. REID, G. M. WARD, AND R. L. SALSBURY 439
A study of the use of the antioxidant nordihydroguaiaretic acid in dairy products. I. Its antioxygenic properties in milk. J. W. STULL, E. O. HERREID, AND P. H. TRACY 449
Vitamin D content of roughages. J. A. NEWLANDER 455
The effect of soya-phosphatides on the absorption and utilization of vitamin A in dairy animals. G. C. ESH, T. S. SUTTON, J. W. HIBBS, AND W. E. KRAUSS 461
Carotene and vitamin A in the colostrum of cows of typical Indian breeds. B. C. RAY SARKAR 479
Comparative antirachitic value of field-cured hay, barn-dried hay, and wilted grass silage for growing dairy calves. L. A. MOORE, J. W. THOMAS, W. C. JACOBSON, C. G. MELIN, AND J. B. SHEPHERD 489
The effect of streptomycin upon the livability and bacterial content of bovine semen. J. O. ALMQUIST, P. J. GLANTZ, AND W. T. S. THORP 501
Effect of ultraviolet irradiation on bacteriophage active against Streptococcus lactis. G. I. GREENE AND F. J. BABEL 509
Abstracts of literature A73

JULY, NO. 7

The keeping quality, solubility and density of powdered whole milk in relation to some variations in the manufacturing process. I. Keeping quality. LOUIS J. MANUS AND U. S. ASHWORTH 517
Beneficial effect and economic importance of using all colostrum produced in calf raising. H. E. KAESER AND T. S. SUTTON 523
Carotene requirements for Guernsey and Jersey calves as determined by spinal fluid pressure. L. A. MOORE, J. F. SYKES, W. C. JACOBSON, AND H. G. WISEMAN 533
Manufacture of powdered cream for whipping by aeration. HARRY PYENSON AND P. H. TRACY 539
Effect of delay in diluting and cooling on keeping quality of bull semen. H. W. ANDERSON AND D. M. SEATH 551
Effect of feeding tocopherols to dairy cows on the quantity and the fat content of milk produced. T. W. GULLICKSON, J. B. FITCH AND L. O. GILMORE 557
The elimination of interfering substances in the Kay-Graham phosphatase test when used for hard ripened cheese. F. V. KOSIKOWSKY AND A. C. DAHLBERG 561
Dehydrated sweet potatoes as a concentrate feed for dairy cattle. ROBERT E. MATHER, WOODROW N. LINKOUS, AND JAMES F. EHEART 569
A simple color test as an aid in grading farm-separated cream. T. J. CLAYDON 577
The effect of preparation of the cow on the rate of milking. VEARL R. SMITH AND W. E. PETERSEN 589
The reducing capacity of milk and milk products as measured by a modified ferricyanide method. L. K. CROWE, ROBERT JENNESS, AND S. T. COULTER 595
The influence of Mycotorula lipolytica lipase upon the ripening of blue cheese made from pasteurized homogenized milk. I. I. PETERS AND F. E. NELSON 611

Moisture studies in dry products of milk. II. Estimating water of crystallization of alpha-lactose in dry whey solids. R. P. Choi, C. M. O'Malley, and B. W. Fairbanks 619
Abstracts of literature A93

AUGUST, NO. 8

The nutritive value of homogenized milk: A review. G. M. Trout 627
Abstracts of papers presented at the 43rd annual meeting 657
Proceedings of the 43rd annual meeting 731
Abstracts of literature A109

SEPTEMBER, NO. 9

The effect of pyridium, penicillin, furacin, and phenozethol upon the livability of spermatozoa and upon the control of bacteria in diluted bull semen. R. H. Foote and G. W. Salisbury 763
The effect of sulfonamides upon the livability of spermatozoa and upon the control of bacteria in diluted bull semen. R. H. Foote and G. W. Salisbury 769
Breeding behaviour, spermatogenesis, and semen production of mature dairy bulls fed rations low in carotene. R. W. Bratton, G. W. Salisbury, T. Tanabe, C. Branton, E. Mercier, and J. K. Loosli 779
Further studies of the nutritive value of butterfat fractions. H. Nath, V. H. Barki, C. A. Elvehjem, and E. B. Hart 793
Sacral deformity in the "wrytail" abnormality in cattle. Lester O. Gilmore and Alvin F. Sellers 797
Frozen homogenized milk. IV. Keeping quality of frozen homogenized milk after thawing. C. J. Babcock, Capt. Joseph N. Stabile, Ernest Windham, LaRue B. Evans, and Col. Raymond Randall 805
Frozen homogenized milk. V. Effect of age before freezing on the keeping quality of frozen homogenized milk. C. J. Babcock, Capt. Joseph N. Stabile, Ernest Windham, LaRue B. Evans, and Col. Raymond Randall 811
Fertility level of bull semen diluted at 1:400 with and without sulfanilamide. G. W. Salisbury and R. W. Bratton 817
An analysis of the results of the 1947 collegiate students' international contest in judging dairy products. G. M. Trout, E. O. Anderson, C. J. Babcock, P. A. Downs, and F. H. Herzer 823
Manometric measurement of the gas desorbed from vacuumized whole milk powder. J. H. Hetrick and P. H. Tracy 831
Abstracts of literature A131

OCTOBER, NO. 10

The effect of agitation upon the livability of bovine spermatozoa. P. W. Prince and J. O. Almquist 839
Heat inactivation of milk phosphatase in dairy products. George P. Sanders and Oscar S. Sager 845
The adaptability of two strains of lactic streptococci to growth in the presence of homologous bacteriophage. R. O. Wagenaar and C. C. Prouty 859
Effect of high-temperature short-time heat treatments on some properties of milk. I. Inactivation of the phosphatase enzyme. J. H. Hetrick and P. H. Tracy 867
Effect of high-temperature short-time heat treatment on some properties of milk. II. Inactivation of the lipase enzyme. J. H. Hetrick and P. H. Tracy 881
Properties of the colostrum of the dairy cow. II. Effect of prepartal rations upon the nitrogenous constituents. D. B. Parrish, G. H. Wise, J. S. Hughes, and F. W. Atkeson 889

The value of winter pasture and sweet potato meal for lactating dairy cows. JENNINGS B. FRYE, JR., GEORGE E. HAWKINS, JR., AND HERBERT B. HENDERSON 897
The determination of butterfat in ice cream employing mixed perchloric and acetic acids. G. FREDERICK SMITH, J. S. FRITZ, AND HARRY PYENSON 905
The nutrition of the newborn dairy calf. II. Effect of dietary tryptophan on the urinary excretion of niacin and its metabolites by young dairy calves. G. C. ESH AND T. S. SUTTON 909
The oxidized flavor in milk and dairy products: A review. GEORGE R. GREENBANK 913
Abstracts of literature A145

NOVEMBER, NO. 11

The keeping quality, solubility and density of powdered whole milk in relation to some variations in the manufacturing process. II. Solubility and density. LOUIS J. MANUS AND U. S. ASHWORTH 935
Effect of thyroxine on oxygen consumption of bovine spermatozoa and semen. A. B. SCHULTZE AND H. P. DAVIS 946
Retention of ascorbic acid, changes in oxidation-reduction potential, and the prevention of an oxidized flavor during freezing preservation of milk. R. W. BELL 951
Lipid deterioration in dairy products. The stability of milk fat and fat-soluble vitamins as determined by the re-emulsification test. VLADIMIR N. KRUKOVSKY, E. S. GUTHRIE, AND FRANK WHITING 961
Lactating factors for dairy cows in dried grapefruit peel. R. N. DAVIS AND A. R. KEMMERER 973
The nutrition of the newborn dairy calf. III. The response to a photolyzed milk diet. R. G. WARNER AND T. S. SUTTON 976
Some changes in dry whole milk during storage. S. T. COULTER, ROBERT JENNESS, AND L. K. CROWE 986
Abstracts of literature A151

DECEMBER, NO. 12

In memory of Robert Bear Stoltz. L. H. BURGWALD 1005
The influence of water level and temperature of storage on carotene preservation in dehydrated alfalfa, cereal grasses and mixed feeds. A. W. HALVERSON AND E. B. HART 1008
Studies on ruminal gas formation and on consumption of alfalfa pasture by cattle. H. H. COLE AND MAX KLEIBER 1016
A study of the use of the antioxidant nordihydroguaiaretic acid in dairy products. II. Its antioxygenic properties in unsweetened frozen cream. J. W. STULL, E. O. HERREID AND P. H. TRACY 1024
The relation between the month of calving and yearly butterfat production. MOHAMED M. OLOUFA AND I. R. JONES 1029
Some factors influencing the male hormone content of cow manure. C. W. TURNER 1032
The influence of the ration and rumen inoculation on the establishment of certain microorganisms in the rumens of young calves. J. W. HIBBS AND W. D. POUNDEN 1041
The influence of the ratio of grain to hay in the ration of dairy calves on certain rumen microorganisms. W. D. POUNDEN AND J. W. HIBBS 1051
The influence of the ration and early rumen development on the changes in the plasma carotenoids, vitamin A, and ascorbic acid of young dairy calves. J. W. HIBBS AND W. D. POUNDEN 1055
The effect of supplemental vitamin A upon the growth, blood plasma carotene, vitamin A, inorganic calcium, and phosphorus of Holstein heifers. R. H. ROSS AND C. B. KNODT 1062
Collegiate students' international contest in judging dairy products 1068

Circulation of the Journal of Dairy Science 1071
Author index of original articles 1108
Subject index of original articles 1117
Abstracts of literature A159
Author index of abstracts A167
Subject index of abstracts A177
Officers of the Association ii
Table of contents viii
Errata viii

ERRATA, VOL. XXXI

No. 4, page 297, lines 4 and 7. *Nitrate* should read *nitrite.*
No. 8, page 717, line 32. *High* should read *low.*
No. 9, page 768, line 18. *763–768* should read *769–777.*

see it in *ACTION on

- BUTTERMILK
- CHOCOLATE MILK
- ICE CREAM MIX
- SKIM MILK
- SOUR CREAM
- STARTER
- SWEET CREAM
- SWEETENED CONDENSED MILK
- WHOLE MILK
- SYRUPS

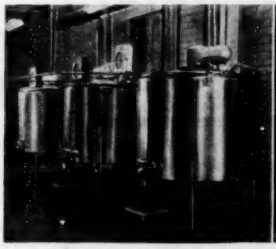
On **every** application **everywhere,** the Mojonnier Vat is in a class by itself! Imitated but never equalled, this unit is the result of years of skilled engineering and long production line experience. Check its features of Simplified Design, Zone-Control, Counter-Current Flow, Coil-Free Interior, Fastest Heating and Cooling, All-Welded Stainless Steel Sanitary Construction, Operating Flexibility, Control and Economy, and you'll **know** why it's rated the No. 1 vat by production men all over the world. Let the experienced Mojonnier Engineer consult with you now about the vat to best serve your particular application requirements. Write:

MOJONNIER BROS. CO.
4601 W. Ohio St., Chicago 44, Illinois

**Send for the name of the plant nearest you where the Mojonnier Vat is in operation.*

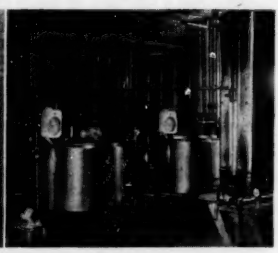
Mojonnier
Custom-Engineered
ZONE CONTROL VATS

Other Mojonnier engineered products widely used by the Dairy Industry include: *Compact Coolers • Cold-Wall Tanks • Tubular Heat Exchangers • Vacuum Pans • Tubular Evaporators • Conveyors • Testers • Fillers • Processed Cheese Kettles • Case Washers • Cut-Wrap Machines*



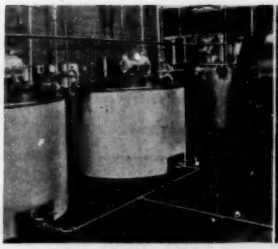
CONDENSED MILK

Three 600 gal. vats in operation cooling condensed milk at McDonald Cooperative Dairy Co., Chesaning, Mich.



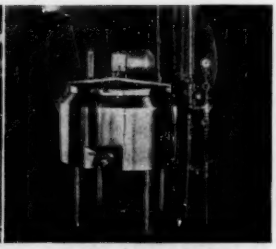
CREAM

These vats are used in the processing of heavy cream at plant of Jersey Milk and Cream Co., La Fargeville, N. Y.



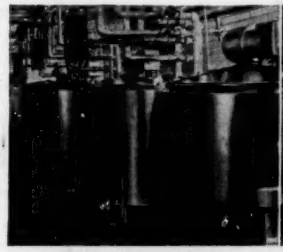
ICE CREAM MIX

Two 500 gal. vats in mix room at Central Ice Cream, Chicago. Mix is pasteurized, then pumped to surface cooler.



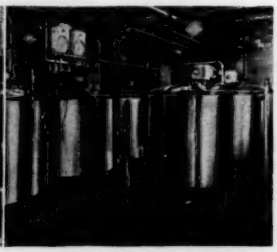
CULTURE VAT

50 gallon vat at Detroit Creamery producing cultures for buttermilk and acidophilous milk.



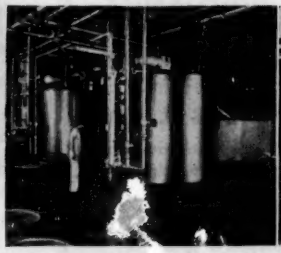
CHOCOLATE & MILK

Four 600 gal. vats in operation in large, Toledo, Ohio, dairy processing all milk products.



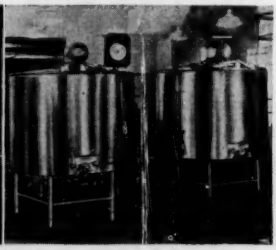
BUTTERMILK & CREAM

Battery of six 600 gal. vats at Ira Wilson Co., Detroit, Mich. processing cream and buttermilk.



CONDENSED MILK

Two vats cooling sweetened condensed and plain condensed milk. Equipped with plastic scrapers to insure uniform milk sugar crystallization.



CREAM

Cream from separator is heated to 161° F, cooled over surface coolers, then to these two 800 gal. vats for holding at 40° F. At Pabst Farms, Oconomowoc, Wis.

Your advertisement is being read in every State and in 25 Foreign Countries

3 WAY IMPROVEMENT For Your DAIRY PRODUCTS

with

'PROVALAC'

Reg. U. S. Pat. Off.

—1. RICH "JUNE" COLOR
—2. DELICIOUS "JUNE" FLAVOR
—3. UNIFORM "JUNE" VITAMIN A

'Provalac' helps restore "June" qualities year 'round—supplies carotene in convenient, easy-to-use form. Write for literature and Free Demonstration Kit showing "before and after" effects of 'Provalac.'

Reg. U. S. GBI Pat. Off.

GENERAL BIOCHEMICALS, INC.
20 LABORATORY PARK • CHAGRIN FALLS, OHIO

BUILD CONSUMER FAVOR THE PROVALAC WAY

Reg. U.S GBI Pat. Off.

'FRIGIDRY'

TRADE MARK

DAIRY CULTURES

Save Time—Save Money — Avoid Trouble. Use rapid-growing 'Frigidry' cultures to produce mother culture in one generation and take guess work out of making good buttermilk, butter and cheese.

LYOPHILIZED* for UNIFORMITY • VIABILITY • STABILITY

*New high-vacuum, sub-zero drying process.

FREE—*Write for Booklet No. 206 on production of Cultured Dairy Products.*

GENERAL BIOCHEMICALS, Inc.
20 LABORATORY PARK • CHAGRIN FALLS, OHIO

FLAV-O-LAC FLAKES

THE CULTURE

of definitely better flavor & aroma producing qualities. The standard with foremost operators agricultural schools & colleges.

FLAV-O-LAC FLAKES

(shown) produce a quart of the finest starter on a single propagation. Single bottles $2.00.

SPECIAL FLAV-O-LAC FLAKES "40"

produce 40 quarts of starter on a single propagation. Single bottles $3.50. Plus postage. Free Cultural Manual of Fermented Milk Products on request.

THE DAIRY LABORATORIES

23rd & Locust Sts., Phila. 3, Pa.

DALARE ASSOCIATES

BRANCHES
New York Baltimore Washington

See our catalog in Dairy Industries Catalog

TRADE MARK

BREEDER'S EQUIPMENT CO.

Supplies for Artificial Insemination of Animals

FLOURTOWN, PA.

ARTIFICIAL INSEMINATION

A technical service which contributes so much to the Dairy Industry is worthy of the recognition accorded to other scientific achievements in the same field.

The technician engaged in this work is a true specialist who requires special equipment, designed and manufactured for a special purpose.

The period of makeshift and improvised apparatus is past.

Our facilities are devoted exclusively to the production of the most efficient instruments for successful artificial insemination.

Write for a copy of our newest catalog, which is now available.

Your advertisement is being read in every State and in 25 Foreign Countries

DIVERSEY PLANNED SANITATION

gives dairy plant operators more complete, efficient, convenient, economical cleaning and disinfecting. Technical information available upon request. Your inquiry is invited.

THE DIVERSEY CORPORATION
53 W. Jackson Blvd., Chicago 4, Illinois
In Canada: The Diversey Corporation (Canada) Ltd.
Toronto, Ontario

IMAGINE YOU
WEARING AN ASPHALT RAINCOAT!

● Probably you'd look terrible. But one thing is sure—you'd stay *dry!* For asphalt keeps out moisture. And that's why we use asphalt to help keep Diamond Crystal Salt dry, and prevent caking.

Salt usually cakes in excessive humidity, because moisture condenses on salt particles, forming a thin layer of brine. Then, in dry weather, the brine evaporates and the crystals knit together.

Our research laboratory has found a number of ways to help prevent salt caking. Removal of moisture-attracting impurities, such as calcium chloride, helps. So does complete removal of fines by careful screening. Most important is to provide salt with a moisture- and vapor-resistant package.

Take our Flour Salt bag, for example. It is composed of three 50-lb. and two 25-lb. sheets of kraft, laminated together with 40 lbs. of asphalt per ream. That's a lot of asphalt, and it costs us more money—but our moisture-vapor transmission tests show this bag is worth the extra cost. The bag is even sewn with *waxed thread* to seal the holes made by the sewing-machine needle. That's real *protection*—one reason we have been able to eliminate caking as a major problem!

Want Free Information On Salt? Write Us!

If *you* have a problem involving the use of salt, write our Director of Technical Service. He will be happy to help! Diamond Crystal Salt, Dept. H-13, St. Clair, Mich.

DIAMOND CRYSTAL SALT
ALBERGER PROCESS

Your advertisement is being read in every State and in 25 Foreign Countries

Marschall
RENNET and COLOR

Strong, clean Rennet is important in the making and curing of cheese. Use Marschall Rennet generously for maximum results.

MARSCHALL
DAIRY LABORATORY, INC.
MADISON 3, WISCONSIN

Copies of the 20-Year Index covering Volumes I to XX, inclusive are available at the following prices:

MEMBERS

Cloth Bound	**$2.35**
Paper Bound	**2.00**

NON–MEMBERS

Cloth Bound	**$5.50**
Paper Bound	**5.00**

Your advertisement is being read in every State and in 25 Foreign Countries

Ster-Bac
WILL DO
THE JOB
FOR YOU
IT'S
PERFECT
FOR
TOUGH
SANITIZING
JOBS
Ster-Bac is a quaternary ammonium compound specially developed by careful Klenzade research for the bactericidal treatment of food handling equipment. It is odorless, yet powerful. Penetrates into finest cracks and crevices and is very economical.
Ster-Bac
Ster-Bac . . .
KLENZADE'S
Revolutionary
BACTERICIDE
Use it to sanitize milk cans and other dairy equipment, soda fountains and steam tables, walls, floors and toilets. Excellent for cold storage rooms. Sanitizes dishes, glassware and silver. Sanitizes hands of food handlers.
KLENZADE PROD

You won't find a sanitation program today that is much simpler than the B-K Plan . . . at such low cost. You will get *results* with it, if you follow the easy directions. But remember—no system can produce these results without a certain amount of cleaning and good old fashioned elbow grease.

The B-K Plan stresses, after use, first the rinsing of utensils and equipment in cold water and then the scrubbing in hot water containing soapless General Manual Kleanser. Before milking, rinse milking machines, and utensils, and wipe cow's udder and teats with efficient, inexpensive B-K solution. These simple steps have helped many average-size farms get surprisingly low counts.

B-K* Chlorine-Bearing Powder contains 50% available chlorine. It speedily sanitizes dairy utensils and reduces the number of bacteria that result in poor quality . . . thermodurics and others. General Manual Kleanser loosens milk solids and really *cleans*.

Farm operating costs remain high . . . and past experience shows that milk prices are sometimes reduced without a proportionate lowering of costs. Recommend the simple, economical B-K Plan and you will help both farmer and city milk supply.

Literature explaining the role of bacteria in milk and their control is available for farmers. Programs of education also on request. Send for them—by writing to B-K Division, Pennsylvania Salt Manufacturing Company, 1000 Widener Building, Philadelphia 7, Pa.

*Reg. U. S. Pat. Off.

PENN SALT

Your advertisement is being read in every State and in 25 Foreign Countries

NOTICE TO CONTRIBUTORS

Authorship of Original Articles and Reviews.—Space in the Journal is reserved for the publication of original research voluntarily submitted by members of the association to the JOURNAL and review articles by invitation. In the case of joint authorship the membership ruling applies to one author only.

Papers that have already appeared in print or that are intended for simultaneous publication elsewhere will not be accepted.

Manuscripts.—Manuscripts should be submitted in double spacing on one side of suitable 8½″ × 11″ paper. The original copy—not the carbon—should be furnished, packing it flat—not rolled or folded. All illustrative and tabular material should accompany the manuscript. The position of each illustration and of each table should be clearly indicated in the text

In the case of manuscripts, other than review articles prepared by invitation, that contain more than 12 printed pages, the author is charged at the rate of $5.00 per page for all pages in excess of twelve. This charge is omitted in the case of articles of extraordinary merit.

Manuscripts voluntarily submitted, when approved for publication, will be published in the order of their receipt. Manuscripts should be sent to the Editor, F. E. NELSON, Dept. of Dairy Industry, Iowa State College, Ames, Iowa.

Drawings.—Drawings, diagrams and charts for illustrations should be prepared for reproduction as line drawings or halftone engravings. The original drawings should be done in India ink on white or blue-white tracing cloth, tracing paper, or Bristol board and neatly lettered in India ink. Legendary material on the drawing should be neatly lettered in India ink—not typewritten.

The original drawings—not photographs of the drawings—should accompany the manuscript. Illustrations not in proper finished form will be prepared for publication and the author charged for the cost of the work.

Photographs.—Photographs for halftone reproductions should be glossy prints, free of all imperfections.

Legends.—All illustrative materials, both drawings and photographs, should be accompanied by appropriate legends, typewritten on a separate sheet of paper.

Tabular Material.—Tabular material in the manuscript should be clear, concise and accurate. Simple tables are more effective than complicated ones. If possible, tables should be so organized that they may be set crosswise of the page. In many instances it is possible to materially improve the appearance and usefulness of tabular material without sacrificing completeness of information, by condensing detailed data and presenting them in simple, summarized, tabular form.

References.—References should be listed alphabetically as to authors and numbered; and citations in the text should be made by the number in parentheses, corresponding to the number in the reference list.

Each reference should contain the following data in the following order: Name and initials of author or authors; title of the articles referred to (principal words in the titles of all articles should be capitalized); name, volume, number, page number and year of publication.

Abbreviations of the titles of publications should conform to the standard set by the United States Department of Agriculture given in U. S. Dept. Agr., Misc. Pub. 337, April, 1939.

For uniformity of punctuations the references should conform to the following example: (1) JONES, L. W., AND SMITH, J. D. Effect of Feed on Body of Butter. JOUR. DAIRY SCI., **24**(4): 550–570. 1941.

References should be carefully checked for accuracy by the author.

Write today for descriptive literature on the new Model E and other Gaulin Homogenizers up to 2500 gal. per hr.

Now! A Completely New GAULIN HOMOGENIZER

With New Style Cylinder Construction

THIS new Model E Gaulin Homogenizer, illustrated at left, has top capacity of 200 gallons per hour. It is ideal for the smaller processor requiring 75, 125, or 200 gal. per hr.

The Model E incorporates a cylinder of brand new design and efficiency; concealed motor; and other important features.

Gaulin TRADE MARK

MANTON GAULIN MFG. CO., INC.
44 Garden Street • Everett 49, Mass.
HOMOGENIZERS • HIGH PRESSURE PUMPS

For Clean, Sparkling Bottles use ORVUS

Orvus, the time-tested wetting agent and synthetic detergent

—speeds cleaning action
—boosts the efficiency of the alkali
—assures thorough emulsification
—reduces bottle re-runs, particularly on chocolate drink bottles
—decreases solution drag-out by greatly lowering surface tension

Orvus loses none of its cleaning efficiency in hardest water. Easy to use... economical... a little goes a long way in your soaker tanks.

For further particulars about Orvus, write

PROCTER & GAMBLE
P.O. BOX 599 — CINCINNATI 1, OHIO

Your advertisement is being read in every State and in 25 Foreign Countries

AMERICAN DAIRY SCIENCE ASSOCIATION

INCORPORATED IN THE DISTRICT OF COLUMBIA

Officers

President	P. H. TRACY, Urbana, Illinois
Vice-President	W. E. PETERSON, St. Paul, Minnesota
Secretary-Treasurer	R. B. STOLTZ, Columbus, Ohio
Editor	F. E. NELSON, Ames, Iowa
Director	C. Y. CANNON, Ames, Iowa
Director	S. J. BROWNELL, Ithaca, New York
Director	W. V. PRICE, Madison, Wisconsin
Director	K. L. TURK, Ithaca, New York
Director	J. H. HILTON, Raleigh, North Carolina
Director	P. F. SHARP, Piedmont, California
Director	FORDYCE ELY, Columbus, Ohio

Officers of Sections

DAIRY PRODUCTION SECTION

Chairman	G. H. WISE, Ames, Iowa
Vice-Chairman	L. A. MOORE, Beltsville, Maryland
Secretary	G. M. CAIRNS, College Park, Maryland

DAIRY MANUFACTURING SECTION

Chairman	P. R. ELLIKER, Corvallis, Oregon
Vice-Chairman	E. M. BARKER, Rochester, Minnesota
Secretary	D. V. JOSEPHSON, Columbus, Ohio

DAIRY EXTENSION SECTION

Chairman	E. H. LOVELAND, Burlington, Vermont
Vice-Chairman	G. HEEBINK, Morgantown, West Virginia
Secretary	C. W. REAVES, Gainesville, Florida

Officers of Divisions

SOUTHERN

Chairman	J. P. LaMaster, Clemson, South Carolina
Vice-Chairman	F. H. Herzer, State College, Mississippi
Secretary-Treasurer	D. M. Seath, Lexington, Kentucky

EASTERN

Chairman	A. I. Mann, Storrs, Connecticut
Vice-Chairman	L. R. Dowd, Storrs, Connecticut
Secretary-Treasurer	J. A. Newlander, Burlington, Vermont

WESTERN

Chairman	H. P. Ewalt, Corvallis, Oregon
Vice-Chairman	E. L. Jack, Davis, California
Secretary-Treasurer	G. A. Richardson, Corvallis, Oregon

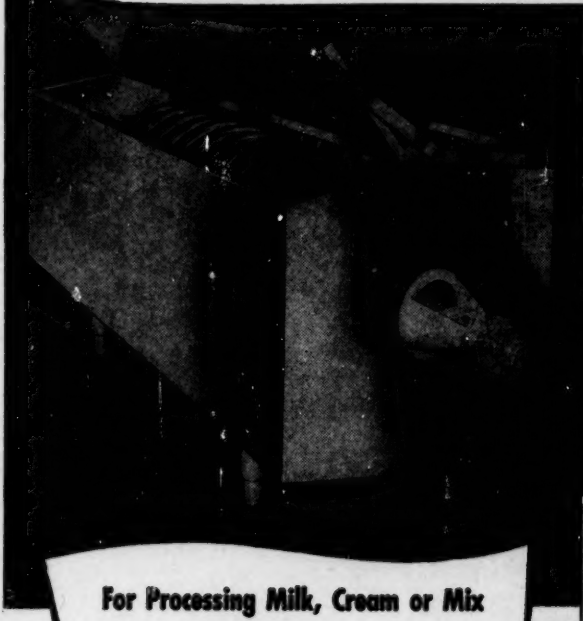
The American Dairy Science Association was organized to advance the general welfare of the dairy industry, especially by the improvement of dairy instruction by the stimulation of scientific research in all phases of the subject and by improvement in methods of conducting extension work.

Membership. Any person is eligible to membership who is formally announced by an Agricultural College or Experiment Station, or by the Bureau of Dairy Industry of the United States Department of Agriculture or by the Canadian Department of Agriculture as an instructor, extension worker, investigator, or administrative officer connected with the dairy industry, or any person filling a position of responsibility connected with the dairy industry who has had a college or university training in technical science, or any person filling a responsible position in the dairy industry of a professional character requiring a technical knowledge of dairying of a high order. The membership fee is $5.00.

The dues are $5.00 a year, $3.00 of which is for a year's subscription to the *Journal of Dairy Science.* Correspondence regarding membership and dues should be addressed to R. B. Stoltz, Ohio State University, Columbus, Ohio.

Now CP Presents

A NEW WIZARD COIL VAT



with

STAINLESS STEEL COIL

and

CP SANITARY SEALS

For Processing Milk, Cream or Mix

For more than a generation, the CP Wizard Coil Vat has been recognized as one of the Industry's most versatile and efficient machines for heating and cooling.

Now CP offers the famous Wizard with new STAINLESS STEEL COIL as well as stainless steel body, and the time proven CP Sanitary Seals. Modern, efficient, and sanitary, the new CP Wizard is worth your consideration for many products and processes. Why not check now!

DAIRY & FOOD PROCESSING EQUIPMENT SUPPLIES REFRIGERATION

General and Export Offices: **1243 W. Washington Blvd., Chicago 7, Illinois**

Atlanta • Boston • Buffalo • Chicago • Dallas • Denver • Houston • Kansas City, Mo. • Los Angeles • Minneapolis • Nashville • New York • Omaha • Philadelphia • Portland, Ore. • St. Louis • Salt Lake City • San Francisco • Seattle • Toledo, Ohio • Waterloo, Ia.

CREAMERY PACKAGE MFG. CO. OF CANADA, LTD.
367 King St., West, Toronto 2, Ontario

THE CREAMERY PACKAGE MFG. COMPANY, LTD.
Avery House, Clerkenwell Green, London, England

Your advertisement is being read in every State and in 25 Foreign Countries

Detection of

MOLDS *and* YEASTS

in Dairy Products

BACTO-POTATO DEXTROSE AGAR is recommended for determination of the mold and yeast count of butter. This product is also used extensively for isolation and cultivation of molds and yeasts in other dairy products.

Bacto-Potato Dextrose Agar is prepared according to the formula specified in "Standard Methods for the Examination of Dairy Products" of the American Public Health Association. Medium prepared from the dehydrated product conforms in every way to the standard medium. After sterilization the medium will have a reaction of pH 5.6 which may readily be adjusted to pH 3.5 by addition of sterile tartaric acid.

BACTO-MALT AGAR is also an excellent medium for detection of molds and yeasts in butter. This medium is widely used for determining the mold and yeast count of butter and other dairy products, and is particularly useful in revealing sources of contamination by these organisms.

Bacto-Malt Agar is readily prepared and has a reaction of pH 5.5 after sterilization in the autoclave. This reaction may readily be adjusted to pH 3.5 by addition of lactic acid.

Specify "DIFCO"

THE TRADE NAME OF THE PIONEERS

In the Research and Development of Bacto-Peptone and Dehydrated Culture Media.

DIFCO LABORATORIES

DETROIT 1, MICHIGAN

Your advertisement is being read in every State and in 25 Foreign Countries